PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XIV. Nos. 187—201.
JANUARY—DECEMBER, 1898.

EDITED BY THE SECRETARIES.

LONDON:
GURNEY & JACKSON, 1, PATERNOSTERROW
1899.

RICHARD CLAY AND SONS, LIMITED,
LONDON AND BUNGAY.

DATES OF ISSUE OF THE MONTHLY NUMBERS OF THE JOURNAL OF THE CHEMICAL SOCIETY TO FELLOWS.

January number was issued		18th January.
February	„	15th February.
March	„	15th March.
April	„	15th April.
May	„	16th May.
June	„	16th June.
July	„	13th July.
August	„	4th August.
September	„	2nd September.
October	„	17th October.
November	„	8th November.
December	„	20th December.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR.

£5 to John McCrae, Ph.D., for a research on the acid chlorides of glycollic and mandelic acids and their action on the sodium compounds of ethylic acetoacetate.

£5 to E. P. Perman, D.Sc., to continue his research on the vapour-pressure of aqueous ammonia.

£5 to A. Lapworth, D.Sc., for the further investigation of the sulphonic and other substitution derivatives of camphor.

£5 to John Wade, B.Sc., to continue his research on cyanides.

£5 to F. E. Matthews, Ph.D., to continue his research on the halogen addition compounds of benzene and its derivatives.

£5 to W. J. Elliott, M.A., to continue his research on the action of chloroform and alkaline hydroxides on amido-acids.

£10 to J. Wallace Walker, Ph.D., to continue his investigation of the derivatives of optically active mandelic acid.

£15 to W. J. Pope, for an investigation of the constitution of berberine and other compounds.

£15 to R. S. Morrell, M.A., and J. M. Crofts, B.Sc., to continue researches on the action of (a) ferric chloride on the ethereal salts of ketonic acids, (b) of hydrogen peroxide on carbohydrates in the presence of iron salts.

£25 to A. G. Perkin and J. J. Hummel, to continue their investigation of natural yellow colouring matters.

£10 to F. D. Chattaway, D.Sc., to continue his research on the composition and reactions of nitrogen iodide.

£20 to Prof. R. Meldola, F.R.S., to continue researches on poly-azo-compounds and anhydro-bases.

£10 to D. S. Jerdan, Ph.D., to examine the constitution of the orcinol and phloroglucinol derivatives obtained by the condensation of ethylic acetonedicarboxylate, and the behaviour of its mono- and di-substituted derivatives with sodium.

£10 to F. W. Dootson, M.A., to examine the action of halogens on ethylic acetonedicarboxylate.

£10 to John Harger, Ph.D., to prepare and examine compounds formed from methylsuccinic anhydride and secondary amines, and to work out a method of formation of di-alkyl succinic acids from mono-alkyl compounds.

£15 to W. A. Bone, D.Sc., and J. J. Sudborough, Ph.D., to prepare and examine the acid esters of (methyl) substituted succinic acids, and to attempt the resolution of 'racemic' substituted succinic acids into their optically active constituents.

£10 to J. J. Sudborough, Ph.D., to continue researches on diortho-substituted acids.

£15 to A. W. Crossley, Ph.D., and H. R. Le Sueur, B.Sc., to continue researches on the determination of the constitution of the fatty acids.

£15 to Prof. James Walker, D.Sc., to examine the configuration of camphoric acid and its isomerides with regard to the asymmetric carbon atoms by the electrolysis of allo-campholytic acids.

£10 to A. Lapworth, D.Sc., to examine the action of silver salts on halogen derivatives of camphor and allied compounds.

£10 to W. B. Davidson, Ph.D., to examine the stereoisomerism of diazo-compounds.

£15 to W. J. Pope, to continue researches on enantiomorphism.

LIST OF FELLOWS ELECTED DURING 1898.

Name.	Proposed.	Elected.
Abbott, Albert, B.A.	February 17th	April 21st.
Allhusen, Ernest Lionel, B.Sc.	December 16th, 1897.	February 17th.
Annable, Henry William Coupe	February 17th	April 21st.
Bailey, William Martin	January 20th	February 17th.
Baskerville, Charles, B.Sc., Ph.D.	February 3rd	April 21st.
Bell, Hugh Poynter, B.A.	November 3rd	December 1st.
Berry, Reginald Arthur	,, ,,	,, ,,
Birkett, Walter	June 2nd	,, ,,
Boardman, Thomas Henry, B.A.	November 3rd	,, ,,
Bogert, Marston Taylor, A.B., Ph.B.	,, ,,	,, ,,
Brearley, Harry	May 5th	June 16th.
Brierley, Joseph, B.Sc.	March 3rd	April 21st
Brittain, Charles Edward, B.Sc.	December 2nd, 1897.	February 17th.
Brooke, Arthur, B.A.	November 3rd	December 1st.
Brooks, Cecil Joslin	November 18th, 1897.	February 17th.
Brünnich, Johannes Christian	November 3rd	December 1st.
Bull, Benjamin S., M.A., B.Sc., Ph.D.	December 16th, 1897.	February 17th.
Burge, Charles Henry	November 18th, 1897.	,, ,,
Caldecott, William Arthur, B.A.	December 2nd, 1897.	February 17th.
Campion, Alfred	February 3rd	April 21st.
Cannon, Matthew J.	November 18th, 1897.	February 17th.
Carroll, Charles Robert	November 17th	December 1st.
Castro, John Paul de	November 3rd	,, ,,
Caven, Robert Martin, B.Sc.	February 3rd	April 21st.
Chapman, David Leonard, B.A.	November 3rd	December 1st.
Cooper, A. J. Bullen	January 26th	February 17th.
Cooper, John, B.Sc.	December 2nd, 1897.	,, ,,
Cooper, William R., M.A., B.Sc.	November 18th, 1897	,, ,,
Cowburn, Arthur William	March 3rd	June 16th.
Cowling, Frederick	December 2nd, 1897.	February 17th.
Cox, Frederick Hudson	February 3rd	April 21st.
Crouch, William Samuel	November 3rd	December 1st.
Cunnington, Alfred V., B.A.	,, ,,	,, ,,
Davidson, W. Brown, M.A., Ph.D.	,, ,,	,, ,,
Davies, Charles W. Tisdale	May 19th	June 16th.
Dickson, Samuel	November 3rd	December 1st.
Dodd, Frederick Robertson	November 18th, 1897.	February 17th.
Don, John R., D.Sc. M.A.	January 26th	,, ,,
Dootson, Frederick W., M.A.	,, ,,	,, ,,
Dowzard, Edwin	April 21st	June 16th.
Drake, Francis Alfred, B.Sc.	November 3rd	December 1st.
Dudley, Charles Benjamin, Ph.D.	March 3rd	April 21st.
Edwards, Wilbraham T. A.	December 2nd, 1897.	February 17th.
Ferguson, James Edward	November 3rd	December 1st
Fleming, John Arnold	February 3rd	April 21st.
Foulerton, A. Grant Russell	April 21st	June 16th.
Gardner, Edward	June 16th	December 1st.

Name.	Proposed.	Elected.
Garside, Arthur L. H., B.Sc.	March 3rd	April 21st.
Gidden, William Thomas	February 17th	,, ,,
Gilderdale, Frederick	December 2nd, 1897.	February 17th.
Gilles, William Setten	,, ,,	,, ,,
Glaister, John, M.D.	January 20th	,, ,,
Goldsmith, John Naish, B.Sc., Ph.D.	November 3rd	December 1st.
Guthrie, Alexander, B.Sc.	February 17th	April 21st.
Hadley, E. B.	November 3rd	December 1st.
Hamilton, Oswald	April 21st	June 16th.
Hartridge, Alfred, B.A.	June 2nd	December 1st.
Haworth, John	November 3rd	,, ,,
Heaton, John	February 17th	April 21st.
Hemmy, A. Stanley, B.A., M.Sc.	May 5th	June 16th.
Hendry, Alexander Garden	November 3rd	December 1st.
Hills, Thomas Herbert	December 16th, 1897	February 17th.
Hislop, Lawrence	March 3rd	April 21st.
Hislop, Robert Findlay	May 19th	June 16th.
Hodgson, Harry Pearson	February 3rd	April 21st.
Holroyd, George W. F., B.A.	November 3rd	December 1st.
Homfray, David, B.Sc.	January 20th	February 17th.
Howe, Walter	November 3rd	December 1st.
Hyland, J. Shearson, M.A., Ph.D.	February 17th	April 21st.
Jarvis, George Arthur	April 21st	June 16th.
Jee, Edwin Charles, B.Sc.	February 3rd	April 21st.
Jessop, Samuel Morton	March 3rd	,, ,,
Jones, Edward, B.Sc.	February 3rd	,, ,,
Jones, Thomas Hill	November 3rd	December 1st.
Kay, Reginald Arundale	,, ,,	,, ,,
Lee, Harry Lancelot	April 21st	June 16th.
Lewins, William, B.Sc.	,, ,,	,, ,,
Lowry, Thomas Martin, B.Sc.	February 17th	April 21st.
Martin, George Herbert, B.A.	May 19th	June 16th.
Mascarenhas, John Charles	November 3rd	December 1st.
Masson, George Henry, B.Sc.	March 3rd	April 21st.
McEwen, Atholl Francis	January 20th	February 17th.
Meads, Charles James	May 19th	June 16th.
Miller, William Lash, Ph.D., B.A.	November 17th	December 1st.
Mills, William Hobson, B.A.	December 2nd, 1897	February 17th.
Mitchell, Albert Henry, B.Sc.	February 17th	April 21st.
Morgan, Gilbert Thomas	December 16th, 1897	February 17th.
Moss, William Edward	,, ,,	,, ,,
Nash, Leonard Myddleton	May 5th	June 16th.
Neilson, Alex. MacGillivray	April 21st	,, ,,
Nightscales, Thomas Arthur	November 3rd	December 1st.
Pakes, Walter Charles Cross	March 3rd	April 21st
Parker, Alfred James	February 17th	,, ,,
Pollard, William, B.A., Ph.D.	November 3rd	December 1st.
Poole, Herman	December 16th, 1897.	February 17th.
Pope, Thomas Henry	January 20th	,, ,,

Name.	Proposed.	Elected.
Ratcliffe, Walter	February 3rd.	April 21st.
Ray, John Armstedt, jun., B.A.	November 3rd	December 1st.
Reid, James Brown	November 18th, 1897	February 17th.
Renwick, James Forster	December 2nd, 1897..	,, ,,
Reynolds, William Colebrook	,, ,,	,, ,,
Rich, Edmund Milton	November 3rd	December 1st.
Richards, William	December 16th, 1897.	February 17th.
Rigg, Gilbert	November 3rd	December 1st.
Rofe, Henry John, B.A.	,, ,,	,, ,,
Russell, Edward John, B.Sc.	May 5th	June 16th.
Sand, Henry J. S., Ph.D.	June 16th	December 1st.
Sayer, Harold Charles	November 18th, 1897	February 17th.
Seligman, Richard	November 3rd	December 1st.
Senior, George, B.A.	,, ,,	,, ,,
Sheridan, Matthew Joseph	May 19th	June 16th.
Smiles, Samuel, jun., B.Sc.	November 3rd	December 1st.
Smith, Benjamin Jordan	,, ,,	,, ,,
Smith, Francis Pitt	March 3rd..	April 21st.
Smith, Thomas de, B.A.	,, ,,	,, ,,
Somerville, Henry, B.Sc.	February 3rd	,, ,,
Spivey, William T. Newton, M.A.	March 3rd	,, ,,
St. John, Harry	February 3rd	,, ,,
Stein, Sigmund	May 5th	June 16th.
Steinhart, Oscar Julian, Ph.D.	March 17th.	,, ,,
Stewart, Basil	November 3rd.	December 1st.
Tucker, Samuel Auchmuty, Ph.B.	March 17th.	June 16th.
Walker, Andrew Jamieson, B.A.	December 2nd, 1897..	February 17th.
Walker, Samuel, M.A., B.Sc	February 17th	April 21st.
Waller, Henry French	April 21st.	June 16th.
Walton, Ambrose	November 3rd.	December 1st.
Weissmüller, Ernest Charles	December 2nd, 1897..	February 17th.
Weston, Frank Edwin	May 5th	June 16th.
Whitaker, Edmund Thomas, B.Sc., M.B.	April 21st.	,, ,,
Wild, William Ernest, B.Sc.	,, ,,	,, ,,
Wilder, Frederick Louis	November 17th	December 1st.
Williamson, John Alexander	March 3rd.	April 21st.
Williamson, William	May 5th	June 16th.
Witham, Ernest	March 17th.	,, ,,
Wood, Thomas Barlow, M.A.	March 3rd.	April 21st.
Woodhead, Samuel Allinson, B.Sc.	February 17th	,, ,,
Woods, Charles William Tuthill	June 2nd	December 1st.
Wrench, Charles Arthur	May 5th.	June 16th.
Young, John Henry, B.Sc.	November 3rd	December 1st.

FELLOWS DECEASED.

Name.	Elected.	Died.
Ackland, Sir Thomas J. Dyke	April 7th, 1856	May 29th, 1898.
Burnett, W. R.	May 4th, 1893	October, 1898.
Conroy, Michael	February 15th, 1877	January 19, 1898.
Cook, E. Rider	November 5th, 1874	August 4th, 1898.
Foord, George	February 21st, 1853	May 15th, 1898.
Heywood, J. G.	December 1st, 1887	April, 1898.
Hiepe, W. L.	May 7th, 1891	February 13th, 1898.
Lowe, Charles	December 15th, 1856	November 1st, 1898.
Napier, James	June 21st, 1877	March 17th, 1898.
Newlands, J. A. R.	April 19th, 1860	July 29th, 1898.
Obach, Eugene	May 4th, 1886	December 27th, 1898.
Playfair, The Right Hon. Lord	February 23rd, 1841	May 29th, 1898.
Prentice, Manning	May 16th, 1864	November 20th, 1898.
Seely, H. W.	June 21st, 1888	August 4th, 1898.
Spencer, Samuel	February 6th, 1879	October 14th, 1898.
Smith, Matthew	December 5th, 1895	March, 1898.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1898.

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January 20th.		
1. The preparation of pure iodine. By Bevan Lean, D.Sc., B.A., and W. H. Whatmough	5	148
2. Derivatives of bromotolylhydrazine. By J. T. Hewitt, M.A., D.Sc., and F. G. Pope	7	174
3. Researches on the terpenes. II. On the oxidation of fenchene. By John Addyman Gardner and George Bertram Cockburn	8	275
4. The action of alkalis on amides. By Julius B. Cohen, Ph.D., and Charles E. Brittain, B.Sc.	10	157
5. The formation of monomethylaniline from dimethylaniline. By Julius B. Cohen, Ph.D., and Harry T. Calvert, B.Sc.	10	163
6. Note on the aluminium-mercury couple. By Julius Cohen, Ph.D., and Harry T. Calvert, B.Sc.	10	—
7. Action of chloroform and alkaline hydroxides on the nitrobenzoic acids. By Walter J. Elliott, M.A.	10	145
February 3rd.		
8. The volumetric estimation of sodium. By H. J. H. Fenton, M.A.	21	167
9. The atomic weight of boron. By F. P. Armitage	22	—
10. Rate of escape of ammonia from aqueous solution. By E. P. Perman, D.Sc.	24	511
11. On the dissociation of potassium platinichloride in dilute solution: and the production of platinum monochloride. By E. Sonstadt	25	—
12. Effect of the mono-, di-, and tri-chloracetyl groups on the rotatory power of methylic and ethylic glycerates and tartrates. By Percy Frankland, F.R.S., and Thomas Stewart Patterson, Ph.D.	28	181
13. The rotation of ethylic and methylic di-monochloracetyl-tartrates. By Percy Frankland, F.R.S., and Andrew Turnbull, Ph.D.	29	208
February 17th.		
14. Observations on the influence of the silent discharge of electricity on atmospheric air. By W. A. Shenstone and W. T. Evans	39	246

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15. Some lecture experiments. By J. Tudor Cundall, B.Sc.	40	—
16. Note on the preparation and properties of *o*-chlorobromobenzene. By J. J. Dobbie, M.A., D.Sc., and Fred Marsden, M.Sc., Ph.D.	41	254
17. The ultraviolet absorption spectra of some closed chain carbon compounds. By W. N. Hartley, F.R.S., and J. J. Dobbie, M.A., D.Sc.	41	598
18. Note on the absorption bands in the spectrum of benzene. By W. N. Hartley, F.R.S., and J. J. Dobbie, M.A., D.Sc.	42	695
19. A chemical examination of the constituents of Indian and American podophyllum. By Wyndham R. Dunstan, F.R.S., and T. A. Henry	42	209
20. The volatile constituents of the wood of *Goupia tomentosa*. By Wyndham R. Dunstan, F.R.S., and T. A. Henry	44	226
21. On oxycannabin from Indian hemp. By Wyndham R. Dunstan, F.R.S., and T. A. Henry	44	—
22. On the condensation of formaldehyde with ethylic malonate, and on *cis*- and *trans*-tetramethylenedicarboxylic acids (1:3). By E. W. Haworth and W. H. Perkin, jun.	45	330
23. Formation of ethylic dihydroxydinicotinate from ethylic cyanacetate. By S. Ruhemann, Ph.D., M.A., and K. C. Browning, B.A.	47	280
March 3rd.		
24. Preparation of anhydrous hydrogen cyanide and carbon monoxide. By John Wade, B.Sc., and Laurence C. Panting, M.B.	49	255
25. Production of some nitro- and amido-oxylutidines. By J. N. Collie, Ph.D., F.R.S., and Thomas Tickle	50	229
26. Production of some nitro- and amido-oxylutidines. Part II. By Miss L. Hall and J. Norman Collie, Ph.D., F.R.S.	51	235
27. On benzene hexabromide. By F. E. Matthews, Ph.D.	52	243
28. Note on the action of bromine on benzene. By J. Norman Collie, Ph.D., F.R.S., and Colin C. Frye	52	241
29. Note on manganic salts. By C. E. Rice, B.A.	53	258
30. Some chemical properties of concentrated solutions of certain salts. Part I. Potassium carbonate. By W. Colebrook Reynolds	53	262
31. The colouring matters of the Indian dyestuff *Delphinium zalil*. By A. G. Perkin and J. A. Pilgrim	55	267
32. Some metallic salts of natural yellow colouring matters. By A. G. Perkin and P. J. Wood	56	—
33. The interaction of magnesium and solution of copper sulphate. By Edward Divers, M.D., F.R.S.	57	—

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March 17th.		
34. The reduction of bromic acid and the law of mass action. By Winifred Judson, B.Sc., and J. Wallace Walker, M.A., Ph.D.	64	410
35. The action of ferric chloride on the ethereal salts of ketone acids. By R. S. Morrell, M.A., Ph.D., and J. M. Crofts, B.A., B.Sc.	65	345
36. Note on the volatility of sulphur. By T. C. Porter, M.A.	65	—
37. Cannabinol. By T. B. Wood, M.A.; W. T. N. Spivey, M.A., and T. H. Easterfield, M.A., Ph.D.	66	—
38. Contributions to the chemistry of thorium. By Bohuslav Brauner, Ph.D.	67	951
39. On the atomic weight of thorium. By Bohuslav Brauner, Ph.D.	68	—
40. On the compound nature of cerium. By Bohuslav Brauner, Ph.D.	69	—
41. On praseodymium and neodymium. By Bohuslav Brauner, Ph.D.	70	—
42. Action of ammonia and substituted ammonias on acetylurethane. By George Young, Ph.D., and Ernest Clark	73	361
43. Formation of oxytriazoles from semicarbazides. By George Young, Ph.D., and Benjamin Mitchell Stockwell, B.Sc.	73	368
44. Formation of $\alpha\alpha'$-dihydroxypyridine. By S. Ruhemann, Ph.D., M.A.	73	350
45. Position-isomerism and optical activity; the comparative rotatory powers of diethylic mono-benzoyl and mono-toluyltartrates. By Percy Frankland, F.R.S., and J. McCrae, Ph.D.	74	307
46. The action of di-isocyanates upon amido-compounds. By H. Lloyd Snape, D.Sc., Ph.D.	75	—
47. The action of alkyl iodides on silver malate and on silver lactate. By Thomas Purdie, F.R.S., and G. Druce Lander, B.Sc.	75	287
48. On the optical rotations of methyl and ethyl tartrates. By J. W. Rodger and J. S. S. Brame	76	301
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49. The carbohydrates of barley straw. By C. F. Cross, E. J. Bevan, and Claude Smith	96	459
50. Isomeric bornylamines. By M. O. Forster, Ph.D.	97	386
51. Some derivatives of benzophenone By Francis Edward Matthews, Ph.D.	97	426
52. Experiments on lauronolic acid. By S. B. Schryver, Ph.D.	98	559
53. The drying of ammonia and of hydrogen chloride. By H. Brereton Baker, M.A.	99	422
54. Note on some of the properties of methylene di-iodide. By H. G. Madan, M.A.	101	—

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55. The condensation of chloral hydrate with orcinol. By J. T. Hewitt, M.A., D.Sc., and F. Dixon, B.Sc.	102	397
56. Note on hexamethylene and its derivatives. By Emily C. Fortey, B.Sc.	103	932
57. The yellow colouring matter of the leaves of *Arctostaphylos uva ursi*. By A. G. Perkin	104	—
58. The yellow colouring matters of various adulterants of Sicilian sumach. Part V. By A. G. Perkin and P. J. Wood	104	374
59. The hydrolysis of starch by acids. By Harold Johnson	106	490
60. Synthesis of *cis*- and *trans*-caronic acid." By W. H. Perkin, jun., and J. F. Thorpe	107	48*
61. Preparation of solid ammonium cyanate. By James Walker and John K. Wood	108	—
62. The chlorine derivatives of pyridine. Part I. By William J. Sell, M.A., F.I.C., and F. W. Dootson, M.A.	110	432
63. Simple experimental illustration of the law of multiples. By A. Wentworth Jones, M.A.	110	—
64. Lauronolic acid. By R. W. Collinson and W. H. Perkin, jun.	111	—
65. The action of aluminium chloride on camphoric anhydride. By Frederic H. Lees and W. H. Perkin, jun.	111	—
66. On the action of bromacetal on the sodium derivative of ethylic malonate. By W. H. Perkin, jun., and C. H. G. Sprankling	112	11*
67. The sulphonation of benzophenone and of diphenylmethane. By Arthur Lapworth, D.Sc.	112	402
68. The separation of optical isomerides. By Frederic Stanley Kipping and William Jackson Pope.	113	—
May 5th.		
69. The action of hydrogen peroxide on carbohydrates in the presence of iron. By C. F. Cross, E. J. Bevan, and Claude Smith	115	463
70. Note on the oxidation of certain acids in presence of iron. By Henry J. Horstman Fenton, M.A.	119	—
71. Properties and relationships of dihydroxytartaric acid. Part II. Metallic Salts. By Henry J. Horstman Fenton, M.A.	120	472
72. The affinity-constants of dihydroxymaleic, dihydroxyfumaric, dihydroxytartaric, and tartronic acids. By S. Skinner, M.A.	121	488
73. Note on the enolic and ketonic forms of ethylic acetoacetate. By R. S. Morrell, M.A., Ph.D., and J. M. Crofts, B.A., B.Sc.	121	—
74. The resolution of tetrahydropapaverine into its optically active components. By William Jackson Pope and Stanley John Peachey	122	893
75. Molecular weights of permanganates, perchlorates, and periodates in solution. By J. Murray Crofts, B.A., B.Sc.	124	593

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76. The action of chlorine on pyridine. By W. J. Sell, M.A., F.I.C., and F. W. Dootson, M.A.	124	442
77. The oxidation of paranitrotoluenesulphonic acid to dinitrostilbenedisulphonic acid and to paranitrobenzaldehydorthosulphonic acid. By R. Herz and W. H. Bentley	125	—
78. Determination of molecular weights: modification of Landsberger's boiling point method. By James Walker and John S. Lumsden	125	502
May 19th.		
79. The liquefaction of hydrogen and helium. By James Dewar, LL.D., F.R.S.	129	528
80. The action of formaldehyde on amines of the naphthalene series. By Gilbert T. Morgan, B.Sc.	132	536
81. On the constitution of oleic acid and its derivatives. Part I. By Frank George Edmed, B.Sc.	133	627
82. Stereoisomeric derivatives of camphor. By T. M. Lowry, B.Sc.	135	569
June 2nd.		
83. The boiling point and density of liquid hydrogen. By James Dewar, LL.D., F.R.S.	146	534
84. The action of hydrogen bromide in presence of ether on carbohydrates and certain organic acids. By Henry J. Horstman Fenton, M.A., and Mildred Gostling, B.Sc.	147	554
85. Production of some chloropyridinecarboxylic acids. By J. N. Collie, Ph.D., F.R.S., and W. Lean	148	588
June 16th.		
86. Preparation of a standard acid solution by direct absorption of hydrogen chloride. By G. T. Moody	149	658
87. Researches on the terpenes. III. Halogen derivatives of fenchene and their reactions. By John Addyman Gardner, M.A., and George Bertram Cockburn, B.A.	150	704
88. Researches on the terpenes. IV. On the oxidation of fenchone. By John Addyman Gardner and George Bertram Cockburn	151	708
89. Nitrocamphor and its derivatives. Part I. Isodynamic forms of nitrocamphor. By T. M. Lowry, B.Sc.	151	986
90. Cannabinol. By T. B. Wood, M.A.; W. T. N. Spivey, M.A.; and T. H. Easterfield, M.A., Ph.D.	153	—
91. An improved form of gas-analysis apparatus. By William A. Bone	154	—
92. Preliminary note on the action of light on acetylene. By William A. Bone and John Wilson	155	—

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93. Reversible zymohydrolysis. By Arthur Croft Hill, B.A.	156	634
94. The solubility of isomeric substances. By James Walker, Ph.D., D.Sc., and John K. Wood, B.Sc.	158	618
95. Note on nitration and substitution in nitro-compounds. By Arthur Lapworth, D.Sc., and Charles Mills	159	—
96. Hydroxydibromocamphorsulphonic acid. A correction. By Arthur Lapworth, D.Sc., and F. Stanley Kipping, D.Sc., F.R.S.	159	—
97. Enantiomorphism. By F. Stanley Kipping, D.Sc., F.R.S., and William Jackson Pope	160	606
98. Azobenzene derivatives of chrysin, euxanthone, gentisin, and morin. By A. G. Perkin	161	659
99. Constituents of the Indian dyestuff "waras." By A. G. Perkin	162	659
100. Note on the oxidation of charcoal by nitric acid. By G. Dixon, M.A., and T. H. Easterfield, M.A., Ph.D.	163	—
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ADDITIONS TO THE LIBRARY DURING THE YEAR 1898.

Allen, A. H. Commercial Organic Analysis. 2nd Edition. Vol. IV. Proteids and Albuminous Principles, Proteoids or Albuminoids. Pp. ix + 579. London 1898.

Attfield, John. Chemistry: General, Medical, and Pharmaceutical; including the Chemistry of the British Pharmacopœia. 17th Edition. Pp. xxii + 885. With 1 Plate and 4 Folding Sheets. London 1898.

Bailey, G. H. The Tutorial Chemistry. Part II. Metals. Pp vi + 295. London 1898.

Baker, R. T., and Smith, H. G. On the Essential Oil and the presence of a Solid Camphor or Stearoptene in the "Sydney Peppermint," *Eucalyptus piperita*, Sm. (Read before the Royal Society of N.S. Wales, August 4, 1897.)

—— On the "Stringybark" Trees of N.S. Wales, especially in regard to their Essential Oils. Part I. (Read before the Royal Society of N.S. Wales, July, 1898.)

Bancroft, W. D. The Phase Rule. Pp. viii + 255. New York 1897.

Beddow, F. First Stage Inorganic Chemistry (Practical). Pp. viii + 165. London 1898.

Berthelot, M. Thermochimie. Tome I. Les lois numériques. Pp. xvii + 737. Tome II. Les données expérimentales. Pp. 878. Paris 1897.

Beesley, Thomas, F.C.S., A memoir of, by H. B. Woodward, F.R.S. Warwick 1897.

Bolas, Thomas. Glass Blowing and Working, for Amateurs, Experimentalists and Technicians. Pp. 212. London 1898.

Boltzmann, Ludwig. Vorlesungen über Gastheorie. I. Theil. 8vo. Pp. viii + 204. Leipzig 1896. (In progress.)

Borns, H. Die Elektrochemie im Jahre 1897. (Reprinted from *Chemischen Industrie*). Pp. 75. Berlin 1898.

Bottone, S. R. Radiography and the X-rays in practice and theory with constructional and manipulatory details. Pp. x + 176. London 1898.

Boyle. Some Considerations Touching the Usefulness of Experimental Naturall Philosophy. First Part: On its usefulness in reference to the minde of man. Pp. 127. Second Part: Of its usefulness to Physik. Pp. 417. Oxford 1663.

Briant, Lawrence. Laboratory Text-Book for Brewers. 2nd Edition. Pp. 356. With 5 unpaged Plates. London 1898.

Briggs, W., and Stewart, R. W. Chemical Analysis, Qualitative and Quantitative. Pp. viii + 128. London 1898.

British Pharmacopœia, The. Pp. xxxii + 535. London 1898.

Campredon, L. Guide pratique du Chimiste Métallurgiste et de l'Essayeur. Pp. iv + 808. Paris 1898.

Classen, A. Handbuch der analytischen Chemie. I. Theil. Qualitative Analyse. Fünfte, vermehrte und verbesserte, Auflage. 8vo. Pp. xii + 242. Stuttgart 1896. (In progress.)

Classen, A., und Roscoe, H. E. Lehrbuch der anorganischen Chemie. Zweiter band. Dritte gänzlich umgearbeitete Auflage des in früheren Auflagen von Roscoe und Schorlemmer bearbeiteten Werkes. Pp. x + 962. Braunschweig 1897.

Collectanea Chemica, being certain select treatises on Alchemy and Hermetic Medicine, by Eirenæus Philalethes, Francis Anthony, George Starkey, Sir George Ripley, etc.

The Secret of the Immortal Liquor called Alkahest.

Aurum Potabile.

The Admirable Efficacy of the True Oil of Sulphur Vive.

The Stone of the Philosophers.

The Bosom Book of Sir George Ripley.

The Preparation of the Sophic Mercury.

8vo. Pp. 160. London 1893.

Dibdin, W. J. The Purification of Sewage and Water. 2nd Edition. Pp. xvi + 276. With 15 folding and unpaged Plates. London 1898.

Don, J. R. The Genesis of certain Auriferous Lodes. Pp. 105. Read before the American Institute of Mining Engineers. February, 1897.

Du Clos. Observations super aquis mineralibus Galliæ. Leiden 1685. One volume with:—

Lister, Martin. Thermarum ac Fontium Angliæ. Leiden 1686.

Fairley, Thomas. On the Water Supplies of Yorkshire. (Reprinted from the *Journal of the Fed. Inst. of Brewing*, 1898.)

Figulus, Benedictus. A Golden and Blessed Casket of Nature's Marvels. Concerning the blessed mystery of the Philosopher's Stone. 8vo. Pp. xxxi + 361. London 1893.

Friedel, M. Charles. Les Actualités Chimiques. Revue des progrès de la Chimie pure et appliquée. Pp. 341. Paris 1896.

Fischer, F. Chemische Technologie an den Universitäten und technischen Hochschulen Deutschlands. 8vo. Pp. 54. Braunschweig 1898.

Fresenius, H. Geschichte des chemischen Laboratoriums zu Wiesbaden während der zweiten 25 Jahre seines Bestehens. 4to. Pp. xx + 128, with a frontispiece and 2 plans, l.p. Wiesbaden 1898.

Fresenius, H. Zur Erinnerung an R. Fresenius. 8vo. Pp. xviii. With a Portrait. Wiesbaden 1897.

Fresenius, Th. W. Ueber die Entwickelung der analytischen Chemie in den letzten 50 Jahren. 8vo. Pp. 16. Wiesbaden 1898.

Garrett, F. C., and Harden, A. An Elementary Course of Practical Organic Chemistry. Pp. viii + 72. London 1897.

Goode, George Brown (Editor). The Smithsonian Institution, 1846—1896. The History of its First Half Century. City of Washington, 1897. Royal 8vo. Pp. x + 856, with 26 full-page illustrations. Smithsonian Publication No. 1086.

George, George. Practical Organic Chemistry. Pp. 96. London 1898.

von Georgievics, G. Lehrbuch der chemischen Technologie der Gespinnstfasern. II. Theil. Pp. ix + 354. With 47 Figs. in the Text. Leipzig 1898.

Groth P. Tabellarische Uebersicht der Mineralien nach ihren krystallographisch-chemischen Beziehungen. Vierte Auflage. Pp. viii + 184. Braunschweig 1898.

Harden, A., and Garrett, F. C. An Elementary Course of Practical Organic Chemistry. Pp. viii + 72. London 1897.

Headden, W. P. Some Products found in the Hearth of an old Furnace upon the dismantling of the Trethellan Tin Works, Truro, Cornwall. (Read before the Colorado Scientific Society, November, 1897).

Hermetic Museum, the. The illustrations produced in facsimile. Containing translations of the following works.

The Golden Treatise concerning the Philosopher's Stone.
The Golden Age come back.
The Sophic Hydrolith, or Water Stone of the Wise.
The Demonstration of Nature.
A Philosophical Summary.
The Path of the only Truth.
The Glory of the World, or Table of Paradise.
The Generation of Metals.
The Book of Alze.
Figures and Emblems concerning the Philosopher's Stone.
The Practice and Keys of Basil Valentine.
The Ordinal of Alchemy.

The Testament of John Cremer, sometime Abbot of Westminster.
The New Light of Alchemy.
The Sulphur of the Philosophers.
An Open Entrance to the Closed Palace of the King.
A Subtle Allegory concerning the Secrets of Chemistry.
The Metamorphosis of Metals.
A Short Guide to the Celestial Ruby.
The Fount of Chemical Truth.
The Golden Calf.
The All-wise Doorkeeper.

2 vols. 4to. Pp. xi + 357: and 352. London 1893.

Hintz, Ernst. Ueber Gasglühlicht. 8vo. Pp. 45. Wiesbaden 1898.

van't Hoff, J. H. Leçons de Chimie Physique. Première Partie. La Dynamique Chimique. Traduit par M. Corvisy. 8vo. Pp. 263. Paris 1898.

Howe, Jas. Lewis. Bibliography of the Metals of the Platinum Group: Platinum, Palladium, Iridium, Rhodium, Osmium, Ruthenium. City of Washington, published by the Smithsonian Institution, 1897. 8vo. Pp. 318. From Smithsonian Miscellaneous Collections, 38, (No. 1084).

Jacobson, Paul, und Meyer, Victor. Lehrbuch der organischen Chemie. Zweiter Band. Erste Abteilung. Pp. i + 320. Leipzig 1895. Zweiter Abt. Pp. 321—576. Leipzig 1896. (In progress.)

Janus Lacinius. The New Pearl of Great Price. A treatise concerning the treasure and most precious stone of the philosophers. Illustrated with symbolical designs. 8vo. Pp. xi + 441. London 1893.

Jones, Chapman. An Introduction to the Science and Practice of Qualitative Chemical Analysis. (Inorganic.) Pp. viii + 213. London 1898.

Jones, H. C. The Freezing-Point, Boiling-Point, and Conductivity Methods. Pp. vii + 64. Easton, Pa., 1897.

Edward Kelley. The Englishman's two excellent treatises concerning the Philosopher's Stone, together with the Terrestrial Theatre of Astronomy. 8vo. Pp. lxvii + 153. London 1893.

Landauer, John (trans. Tingle, J. B.). Spectrum Analysis. With 44 Figs. in the Text. Translated by J. Bishop Tingle. Pp. x + 239. New York 1898.

Lister, Martin. Thermarum ac Fontium Angliæ. Leiden 1686. One volume with:—

Du Clos. Observationes super aquis mineralibus Galliæ. Leiden 1685.

Liversidge, A. Abbreviated names for certain Crystal forms.

—— Models to show the Axes of Crystals.

Liversidge, A. Variation in the amount of free and albuminoid Ammonia in Waters, on keeping; On the Corrosion of Aluminium.

—— Crystallised Carbon Dioxide; on the Internal Structure of Gold Nuggets; Contributions to the Bibliography of Gold; Experiments on the Waterproofing of Bricks and Sandstones with Oils; Experiments upon the Porosity of Plasters and Cements. (Reprinted from the *Transactions* of the Australasian Association for the Advancement of Science.)

—— On some New South Wales and other Minerals. Note No. 7.

—— On the Amount of Silver and Gold in Sea Water.

—— The Removal of Gold and Silver from Sea Water by Muntz Metal Sheathing. (Reprinted from the *Transactions* of the R.S.N.S.W.)

Louis, D. A. The Iron Industry of Hungary. (Reprinted from the *Journal of the Iron and Steel Inst. No. II.*, 1897).

Lupton, Sydney. Notes on Observations; being an outline of the methods used for determining the meaning and value of quantitative observations and experiments in Physics and Chemistry, and for reducing the results obtained. Pp. ix + 126. London 1898.

Maercker, M. Handbuch der Spiritusfabrikation. Siebente, vollständig neubearbeitete Auflage. Mit 216 in den Text gedruckten Abbildungen. Pp. xxiv + 783. Berlin 1898.

Mallet, J. W. On the Solubility of Ammonia in Water at Temperatures below 0°C.

—— Note on a somewhat remarkable case of the rapid Polymerisation of Chloral. (Reprinted from the *American Chemical Journal*, vol. xix. 1897.)

Manch, R. Ueber die Löslichkeit von Alkaloiden, Glykosiden und Bitterstoffen in concentrieter wässriger Chloralhydratlösung und die Verwerthung des Chloralhydrats in der toxikologischen Analyse. Pp. 26. Strassburg 1897.

Mathews, J. A. The Action of Nitriles upon Aromatic Acids. Easton 1898.

Meyer, Victor, und Jacobson, Paul. Lehrbuch der organischen Chemie. Zweiter Band. Erste Abteilung. Pp. i + 320. Leipzig 1895. Zweiter Abt. 8vo. Pp. 321—576. Leipzig 1896. (In progress.)

von Meyer, E. (trans. McGowan, G.). A History of Chemistry from Earliest Times to the Present Day. 2nd Edition. Translated by George McGowan. Pp. xxiii + 931. London 1898.

Mez, C. Mikroskopische Wasseranalyse. Anleitung zur Untersuchung des Wassers mit besonderer Berücksichtigung von Trink- und Abwasser. Pp. xvii + 631. Mit 8 lithographisten Tafeln und in den Text gedruckten Abbildungen. Berlin 1898.

Mitchell, A. H. Quantitative Practical Chemistry. Part I., Elementary Stage. Pp. 70. Part II., Advanced Stage Quantitative (Volumetric) and Qualitative Analysis. Pp. 76. Reading. 1898.

Neumann, Bernhard. Theorie und Praxis der analytischen Elektrolyse der Metalle. 8vo. Pp. viii + 224. Halle a.-S. 1897.

Neumann, Bernhard. The theory and practice of Electrolytic Methods of Analysis, translated by J. B. C. Kershaw. Pp. x+254. London 1898.

Neumeister, R. Lehrbuch der physiologischen Chemie mit Berücksichtigung der pathologischen Verhältnisse. Zweite Auflage. Pp. xviii + 927. Mit 1 lithographischen Tafel. Jena 1897.

Nietzki, Rudolf. Chemie der organischen Farbstoffe. Dritte vermehrte Auflage. Pp. x + 343. Berlin 1897.

Obach, E. F. A. Cantor Lecture on Gutta Percha. Pp. 102. (Reprinted from the *Journal of the Society of Arts.*) London 1898.

Oesterle, O., und Tschirch, A. Anatomischer Atlas der Pharmakognosie und Nahrungsmittelkunde. Erste Abteilung. Tafel 1—40. 4to. Pp. iv + 174. Leipzig 1896. (In progress.)

Paracelsus. The hermetic and alchemical writings of Aureolus Philippus Theophrastus Bombast of Hohenheim, called Paracelsus, edited by A. E. Waite. 2 vols. 4to. Pp. xvi + 394 and viii + 396. London 1894.

Patents for Inventions, Abridgments of Specifications. Class I. Acids, Alkalies, Oxides, and Salts. Inorganic. Periods 1884—88. London 1896.

Patent Office Library, Catalogue of. Arranged Alphabetically. Vol. I. Authors. Pp. 1007. London 1898.

Pharmaceutical Formulas: A Book of Useful Recipes for the Drug Trade, collated chiefly from *The Chemist and Druggist* and *The Chemists' and Druggists' Diaries.* By Peter MacEwan. Pp. v + 664. London 1898.

Romanoff, L., et Spring, W. Sur la solubilité réciproque du bismuth et du plomb dans le zinc existence d'une température critique. Bruxelles 1896.

Roscoe, H. E., und Classen, A. Lehrbuch der anorganischen Chemie Zweiter band. Dritte gänzlich umgearbeitete Auflage des in früheren Auflagen von Roscoe und Schorlemmer bearbeiteten Werkes. Braunschweig 1897.

Royal Agricultural Society, Journal of the. Vols. I—XXV, 1st Series, with General Index, 1840—1864. Vols. I—XXV, 2nd Series, with General Index, 1865—1889. Vols. I—VI, 3rd Series, 1890—1895.

Royal Society, The Record of the. No. 1. 1897. Pp. vi + 224. London 1897.

Royal Society, Yearbook of the, 1896–97. No. 1. London 1897.

Ryn, W. van. Die Stereochemie des Stickstoffs. Gekrönte Preisschrift von der Universität Zürich. Pp. 148. Zürich 1897.

Sachs, E. O. What is fire protection? A study by. Pp. 37.

Fire prevention, some American opinions on. Pp. 16.

Sachs, E. O. Paris Charity Bazaar Fire. A paper by. Pp. 52.

(Publications of the British Fire Prevention Committee, Nos. 1, 2, and 3.)

Schaer, E. Arzneipflanzen als Fischgifte. Pp. 65. Strassburg. 1897.

Schäfer, E. A. Text-book of Physiology. Vol. I. Pp. xviii + 1036. London 1898.

Smith, H. G., and Baker, R. T. On the Essential Oil and the presence of a Solid Camphor or Stearoptene in the "Sydney Peppermint," *Eucalyptus piperita*, Sm. (Read before the Royal Society of N.S. Wales, August 4, 1897.)

—— On the "Stringybark" Trees of N.S. Wales, especially in regard to their Essential Oils. Part I. (Read before the Royal Society of N.S. Wales, July, 1898.)

Smithsonian Institution, The. The History of its first half-century, 1846—1896. Edited by G. B. Goode. Pp. x + 856, with 26 full page illustrations. Royal 8vo. Washington 1897.

Speyers, C. L. Molecular Weights of some Carbon Compounds in Solution. (Reprinted from the *Journal of Physical Chemistry*, December, 1897.)

Spring, W. Sur le role des composés ferriques et des matières humiques les phénomène de la coloration des eaux et sur l'élimination de ces substances sous l'influence de la lumière solaire. Bruxelles 1897.

Observations sur l'hydrolyse du chlorure ferrique. Leide 1897.

Sur le spectre d'absorption de quelques corps organiques incolores et ses relations avec la structure moléculaire. Bruxelles 1897.

Sur la couleur et le spectre d'absorption de quelques corps organiques. Genève 1896.

De la température à laquelle les courants de convection commencent à produire l'opacité d'une colonne d'eau d'une longueur donnée. Bruxelles 1896.

Sur la transparence des solutions des sels incolores. Genève 1896.

De l'influence du temps sur l'agglutination de la craie comprimée. Bruxelles 1895.

Sur la couleur des alcools comparée à la couleur de l'eau. Genève. 1896.

Sur le role des courants de convection calorifique dans le phénomène de l'illumination des eaux limpides. Genève 1896.

Sur un hydrate de trisulfure d'arsenic et sa décomposition par la compression. Bruxelles 1895.

Spring, W. Sur la cause de l'absence de coloration de certaines eaux limpides naturelles. Bruxelles 1898.

Spring W. Uber die physikalischen Veränderungen, die gewisse Schwefelverbindungen unter dem Einfluss der Temperatur erleiden. Leipzig 1895.

Notice bibliographique. Bruxelles 1896.

Spring, W., et Romanoff, L. Sur la solubilité réciproque du bismuth et du plomb dans le zinc existence d'une température critique. Bruxelles 1896.

Storer, F. H. Agriculture in some of its Re[gu]lations with Chemistry. 7th Edition. 3 vols. Vol. I, pp. iv + 620; Vol. II, pp. iv + 602; Vol. III, pp. vi + 679. London 1898.

Symons, Brenton. A Geological Sketch of the Coolgardie Goldfields. Pp. 49. London, 1896.

Threlfall, Richard. On Laboratory Arts. Pp. xii + 338. London 1898.

Tschirch, A., und Oesterle, O. Anatomischer Atlas der Pharmakognosie und Nahrungsmittelkunde. Erste Abteilung. Tafel 1—40. 4to. Pp. iv + 174. Leipzig 1896. (In progress.)

Valentinus, Basilius. The Triumphal Chariot of Antimony, with the commentary of Theodore Kerckringius. Engraved title and plates. 8ov. Pp. xxxiii + 204. London 1893.

Wade, John. Introduction to the Study of Organic Chemistry. Pp. xvi + 460. London 1898.

Williams, C. W. Plates illustrative of the Combustion of the Gaseous Portion of Coal, and of the Modes by which it may be effected in Furnaces. Lithographed in colours by George Smith and Co. 14 plates (7 folding). Liverpool 1841.

Williams, C. W. The Combustion of Coal and the Prevention of Smoke Chemically and Practically Considered. Part the First. Pp. xii + 158 + xxvi. 8vo. London and Liverpool. Second edition, 1841. (With a volume of plates.)

Wollny, Ewald. Die Zersetzung der organischen Stoffe und die Humusbildungen mit Rücksicht auf die Bodencultur. Pp. x + 479. Heidelberg 1897.

Woodward, H. B., F.R.S. A Memoir of Thomas Beesley, J.P., F.C.S. Warwick 1897.

Woods, Hugh. Æther, its nature and place in the universe. London 1898.

Zenetti, Paul. Mikrokrystallinische Niederschläge der Pikrinsäure mit Alkaloiden. Strassburg 1897.

INDEX TO AUTHORS' NAMES.

Armitage, F. P., 22.

Bagnall, E. H., 182.
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ERRATA.

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8	26	*for* "I" *read* "II."
41	1	,, "filled" *read* "fitted.'
41	13	omit "which is then."
58	31	*for* "cuprous" *read* "cupric."
96	6	,, "Claud" *read* "Claude."
99	32	,, "cylic" *read* "cyclic."
149	13	omit "Ph.D."
163	2	*for* "Dickson" *read* "Dixon."
175	26	,, "for" *read* "from."
239	12	,, "Szarasy" *read* "Szarvasy."

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 26/1/1898.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 187. Session 1897–8.

January 20th, 1898. Professor Dewar, F.R.S., President, in the Chair.

Mr. Oscar Guttmann was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. W. M. Bailey, 13, Green Lane Road, New Evington, Leicester; A. J. B. Cooper, Grimston Lawn, Ealing, W.; John R. Don, D.Sc., M.A., Waitaki, Oamaru, N.Z.; F. W. Dootson, M.A., Bryn, Glisson Road, Cambridge; John Glaister, M.D., 4, Grafton Place, Grafton Square, Glasgow; David Homfray, B.Sc., 6, Dartmouth Row, Greenwich, S.E.; A. F. McEwen, 43, Gilmore Road, Lewisham, S.E.; T. H. Pope, South Street, Ponders End.

ELECTION OF FOREIGN MEMBERS.

A ballot for the election of Foreign Members was held, and the following were subsequently declared duly elected:—Professors S. Arrhenius, Th. Curtius, A. P. N. Franchimont, W. Körner, W. Markownikoff, N. A. Menschutkin, H. Moissan, W. Ostwald, F. M. Raoult, I. Remsen, W. Spring, L. J. Troost, P. Waage, J. D. van der Waals.

ANNOUNCEMENT BY THE COUNCIL.

The PRESIDENT said that he was authorised by the Council to make the following statement to the Society:—

"The Council of The Chemical Society have received the following Memorial and enclosures.

Letter addressed to the Fellows by Messrs. Harden and Hartog.

OWENS COLLEGE, MANCHESTER, *October*, 1897.

DEAR SIR,—We desire to ask if you will give your support to the enclosed Memorial to the Council of The Chemical Society, requesting them to propose such alterations in the Rules of the Society as will enable members who reside in the country to record their votes in the election for officers and members of the Council without personal attendance at the General Meeting.

The reasons for the change which we desire are explained in the Memorial itself, of which a draft is enclosed. That the change is practicable is shown by the fact that in Societies like the Society of Chemical Industry, the Institution of Civil Engineers, and the Institution of Electrical Engineers, each containing several thousand members, the regulations allow votes to be recorded by post, as we suggest, and the arrangements are such that the secrecy of the ballot is preserved. Should you approve of it, we should be much obliged if you would kindly sign and return the draft Memorial under cover to one of the undersigned at your early convenience.

We are, dear Sir,

Faithfully yours,

ARTHUR HARDEN.

PHILIP HARTOG.

Memorial.

TO THE PRESIDENT AND COUNCIL OF THE CHEMICAL SOCIETY.

GENTLEMEN,—We the undersigned, Fellows of The Chemical Society, desire to draw your attention to the great change in constitution which has taken place since the Society was originally formed, and to the desirability of making some alteration in the Bye-laws, so as to correspond with this change. Whereas the Society was originally composed in the main of chemists living in London or its immediate neighbourhood, and until 1871 was called on its official publication The Chemical Society of London, since that date it has been called by the more general name (given in the Charter) of The Chemical Society, and at the present time the vast majority of the Fellows resides in other parts of the kingdom.

Under the existing regulations it is, however, practically impossible for this majority to take any share in the government of the Society, since, under Bye-law V., the vote of each member at the election of Officers and Council must be recorded *personally*, and may not be sent by post.

It is of course recognised that a custom has grown up of choosing a

certain proportion of the Officers and Council from among the Fellows who reside in the provinces, but this practice cannot be regarded as a sufficient remedy for the defect in the existing Bye-law, and while we do not wish in any way to express dissatisfaction with the policy of the present or of past Councils, we feel strongly that the Council should be elected by the whole Society, and not by a mere fraction of the Fellows. In this feeling we venture to think that you will concur.

We trust, therefore, that you will see your way to propose to the Society at an early date an alteration of Bye-law V. in the sense we desire, and have the honour to remain, Gentlemen,

Your obedient Servants.

(Signed by 540 Fellows.)

Letter received by the Secretaries, together with the Memorial and Enclosures.

OWENS COLLEGE, MANCHESTER, *December 16th*, 1897.

GENTLEMEN,—We beg to forward herewith a Memorial addressed to the President and Council of The Chemical Society, together with the signatures of over 500 Fellows appended thereto. We also enclose a list of the signatures divided into two sections; (*a*) a list of the signatures appended to the Memorial in the first instance—*i.e.*, before it was circulated among the Fellows of the Society residing in the United Kingdom generally; (*b*) a list of signatures appended subsequently. With reference to the substance of the Memorial, we wish to make one statement. We are aware that in the Charter (on page 8 of the printed text) it is provided that "at all general meetings and meetings of the Council, the majority present, and having the right to vote thereat respectively, shall decide upon the matters propounded at such meetings"; hence in order to render legal the change desired, it would probably be necessary to obtain a Supplemental Charter, allowing members not actually present at meetings to vote by means of balloting papers. It is in this connection material to point out that in order to obtain a revision of Bye-laws precisely similar to that now desired by Fellows of our own Society, a supplemental Charter was quite recently obtained by the Institution of Civil Engineers. We beg to request you to lay the accompanying Memorial and enclosures, and the present letter, before the President and Council of The Chemical Society, and have the honour to remain, Gentlemen,

Your obedient Servants,

ARTHUR HARDEN.

PHILIP HARTOG.

The Secretaries of The Chemical Society.

Owing to the action of the Bye-laws Committee, which was appointed some time ago, the Council is in a position to give an immediate answer to the Memorialists.

The question of the power of the Society to alter the mode of election of the Officers and Council having arisen, the Bye-laws Committee requested the solicitors of the Society, Messrs. Wilson, Bristows, and Carpmael, to submit the following case for legal opinion.

Case for the Opinion of Counsel.

The opinion of Counsel is desired by the President and Council of The Chemical Society under the following circumstances:—

A memorial is being extensively signed by the Fellows of The Chemical Society, addressed to the President and Council of such Society asking that the Bye-laws may be altered so as to allow the votes at the General Annual Meetings to be given by proxy. A printed copy of such Memorial is sent herewith.

The attention of Counsel is directed to page 8 of the printed copy of the Charter of The Chemical Society, which is sent herewith, and also to pages 16 and 17 of such document. On the latter of which pages will be found the present Bye-laws on the subject.

Counsel is desired to advise the President and Council of The Chemical Society whether, under their charter, they have power to alter the Bye-laws so as to provide for the votes at General Meetings being given by proxy.

The following is the opinion of Counsel.

Copy of Opinion of Mr. Cozens-Hardy, Q.C.

I am of opinion that the Charter (p. 8) prohibits voting by proxy and that any Bye-law framed for the purpose of allowing voting by proxy would be repugnant to the Charter (p. 9) and invalid.

Herbert H. Cozens-Hardy.

7 *New Square, Lincoln's Inn,*
December 6, 1897.

This opinion of Mr. Cozens-Hardy, Q.C., makes it clear that the Council of the Society have not the power to propose such an alteration of Bye-law V. as the Memorialists request.

The suggestion made by Messrs. Harden and Hartog in the letter addressed to the Secretaries along with the Memorial, that "*it would probably be necessary to obtain a Supplementary Charter allowing members not actually present at meetings to vote by means of balloting papers*," opens up questions outside the terms of the Memorial, which will necessitate further legal advice. The whole subject is receiving the most careful consideration of the Council."

Of the following papers those marked * were read :—

*1. "The preparation of pure iodine." By Bevan Lean, D.Sc., B.A., and W. H. Whatmough.

Stas, in his *Nouvelles Recherches sur les Lois des Proportions Chimiques*, states that he was only able to find two methods of preparing iodine free from chlorine and bromine. One consisted in precipitating by water iodine dissolved in potassium iodide, the other depended on the decompositions of iodide of nitrogen by heat. Perhaps the main difficulty attached to these methods was the desiccation of the iodine and the removal of hydriodic acid. Neither in his published memoirs nor in his laboratory note-books has Stas stated how he assured himself that his "iodine" was free from other halogens.

A few months ago the authors observed incidentally that no iodine is set free when cuprous iodide is heated, even at its fusion point, in a current of carbonic anhydride, although it is readily evolved when cuprous iodide is heated in air, oxygen, nitric oxide or nitrogen peroxide. The action is represented by the equation $Cu_2I_2 + O_2 = 2CuO + I_2$. No iodine is evolved when cuprous iodide is heated in a vacuum.

The authors have examined the usual methods of preparing cuprous iodide. When a solution of cupric sulphate and a soluble chloride, bromide, or iodide, is saturated with sulphurous acid, cuprous iodide, bromide and chloride may all be precipitated; but there is so great a difference in their degree of solubility that, by securing a proper dilution, it is probable that cuprous iodide can be prepared free from cuprous bromide or chloride. A mixture of cupric sulphate and ferrous sulphate is still less liable to precipitate cuprous bromide and chloride along with cuprous iodide than cupric sulphate saturated with sulphurous acid. The authors have found that cuprous iodide can also be prepared by sprinkling iodoform in small quantities at a time upon a hot surface of copper. On account of the difference in the properties of chloroform, bromoform and iodoform, it is probable that, by this method also, cuprous iodide can be prepared entirely free from bromide or chloride. If, moreover, the cuprous iodide is fused in a current of carbonic anhydride or in vacuo, it can be freed completely from moisture.

Iodine is most conveniently prepared from cuprous iodide by heating it in a stream of dry air at 220—240° and condensing the vapours upon a cold surface. Although the greater portion of the iodine in a given quantity of cuprous iodide is quickly expelled, it is not easy to expel the whole; after heating 1·7101 grams at 400° for 18 hours, 0·15 per cent. of the iodide was still undecomposed—otherwise the relation Cu_2I_2:2CuO could have been utilised for the exact measurement of the atomic weights of copper, iodine, and oxygen. The authors are

making further experiments upon this point. The action of air upon cuprous iodide is not dependent upon the presence of moisture. This is established by sealing cuprous iodide in glass tubes in the presence of phosphoric anhydride.

Iodine liberated as described from cuprous iodide at 240° leaves absolutely no residue when volatilised at 75°. If examined spectroscopically, no evidence of the presence of copper can be found. The melting point (uncorrected) is 112·5—114°.

Whether such iodine is as pure as that prepared by Stas or not, it appears desirable to redetermine the atomic weight of the element prepared by this method.

Discussion.

Dr. Scott remarked that Stas depended on distillation two or three times with anhydrous baryta, and not on calcium nitrate, for the complete removal of water from his iodine. This reagent had also the great advantage of removing any traces of hydriodic acid, the calcium nitrate being only used for the removal of the greater part of the water. Although Stas does not give his methods of testing his iodine for traces of chlorine and bromine, his concluding remarks in that section of his paper evidently show that he had no doubts as to its purity. The marvellous agreement of his results with those of Marignac, who found 100 grams of silver gave 217·5334 of silver iodide, whilst Stas found in his complete synthesis 217·5335, will probably convince most chemists that both were dealing with the same chemical substance.

Mr. R. J. Friswell asked if the author had observed the crystalline form and appearance of the sublimed iodine. He had himself a very interesting experience in this matter with iodine recovered from methyl iodide by Nicholson's method of recovering the iodine, used in methylating rosaniline by mixing the sulphuric acid and sodium bichromate with the waste iodine liquor, the precipitated iodine being washed, pressed and fused under sulphuric acid.

For many years he (Mr. Friswell) had noticed that at times the sulphuric acid used for the fusion contained a mass of minute, violet-brown, glistening plates, but every attempt to collect them failed, the least dilution of the acid causing them instantly to disappear. After some time, however, nearly a pound of a paste or magma of these crystals was obtained in the following way. The acid was allowed to dilute itself by the absorption of water from the air and then run off from the crystals; the magma of crystals was thrown on to a vacuum filter and washed with sulphuric acid of continually increasing dilution and at length with water; the paste was then squeezed and, while moist, sublimed in a beaker covered with a loose glass plate at a temperature of 35—40°.

At first, the ordinary violet plates of iodine appeared, with a little water, but these soon vanished and intensely black, adamantine, solid rhombic (?) crystals appeared. A brownish earthy residue was left. The crystals were of considerable size, a cubic mm. or so in content. He thought that since these had been obtained from iodine continually in use for many years, during which time some tons of iodine had passed through the operation, they might be the companion element which has been suspected. Prof. Ramsay was asked to examine the crystals and the paste from which they had been sublimed, but found that the adamantine crystals gave no residue on sublimation and showed 99·84 per cent. iodine, the deficit being probably due to a slight accidental loss. On sublimation in a vacuum, both the plate-like crystals which first sublimed and iodine purified in the usual way left slight yellowish residues, but these adamantine crystals left none. They were, therefore, pure iodine. He wished to know whether the author's substance resembled these crystals in any way.

The PRESIDENT mentioned, as indicating the general trustworthiness of Stas's observations, that he had recently confirmed Stas's remarkable statement, that, when pure, solid iodine is opaque to light. He inquired whether Dr. Lean had made any experiments with palladious iodide.

Dr. LEAN, in reply, said that he had not noticed anything anomalous in the crystallisation of the iodine. He had observed, however, that his iodine had a black and not a deep violet colour, and that it emitted no visible vapour at the ordinary temperature. Stas had made a similar observation.

The reason he had not made most of his experiments with palladious iodide was that it was so muc h more expensive than cuprous iodide. He had, however, made a few experiments which showed that iodine was very readily liberated when palladious iodide was heated in air.

***2. "Derivatives of bromtolylhydrazine." By J. T. Hewitt, M.A., D.Sc., and F. G. Pope.**

This is a continuation of the work of one of the authors on ortho-substituted phenylhydrazines. The hydrazine was prepared from the amido-compound by the method of Victor Meyer and Lecco (*Ber.*, 1883, **16**, 2976) an alteration being made by pouring the solution of the diazonium salt into the stannous chloride solution. The free hydrazine and the following salts and derivatives are described.

Bromtolylhydrazine, $C_6H_3BrMe(N_2H_3)$, 1 : 3 : 6, colourless needles, m. p. 91°, *hydrochloride*, $C_7H_6Br\cdot N_2H_3,HCl$, colourless needles, m. p. 190°, *nitrate*, $C_7H_6Br\cdot N_2H_3,HNO_3$, colourless plates, m. p. 154°,

sulphate, $(C_7H_6Br\cdot N_2H_3)_2,H_2SO_4$, colourless needles, m. p. 201°, *oxalate*, $(C_7H_6Br\cdot N_2H_3)_2,H_2C_2O_4$, small colourless prisms, m. p. about 150°. *Acetylbromtolylhydrazine*, $C_7H_6Br\cdot NH\cdot NH\cdot COMe$, colourless prisms, m. p. 124°. *Bromtolylsemicarbazide*, $C_7H_6Br\cdot NH\cdot NH\cdot CO\cdot NH_2$, small colourless crystals, m. p. 163°. *Bromtolylallylthiosemicarbazide*, $C_7H_6Br\cdot NH\cdot NH\cdot CS\cdot NH\cdot C_3H_5$, colourless prisms, m. p. 136·5°. *Bromtolylphenylthiosemicarbazide*, $C_7H_6Br\cdot NH\cdot NH\cdot CS\cdot NH\cdot C_6H_5$, small prisms often grouped in radiating clusters, m. p. 142°; the freshly prepared substance usually has a somewhat lower melting point, and this may possibly be a case of isomerism similar to that observed by Marckwald with diphenylthiosemicarbazide (*Ber.*, 1892, **25**, 3098). *Furfuraldehydebromtolylhydrazone*, $C_4H_3O\cdot CH:N_2H\cdot C_7H_6Br$, needles, m. p. 87°. *Benzaldehydebromtolylhydrazone*, $C_6H_5\cdot CH:N_2H\cdot C_7H_6Br$, rhomboidal plates, m. p. 84°. *Salicylaldehydebromtolylhydrazone*, $C_6H_4(OH)\cdot CH:N_2H\cdot C_7H_6Br$, needles, m. p. 109°, and the following bromtolyl hydrazones of:—*pyruvic acid*, $C_7H_6Br\cdot NH\cdot N:CMeCO_2H$, yellow crystals, m. p. 175°: *ethyl pyruvate*, $C_7H_6Br\cdot NH\cdot N:CMeCO_2Et$, tufts of needles, m. p. 84—85°: *potassium pyruvate* (with 3 mols. of water), $C_7H_6Br\cdot NH\cdot N:CMeCO_2K,3H_2O$: *ammonium pyruvate*, $C_7H_6Br\cdot NH\cdot N:CMeCO_2NH_4$, (both these salts are soluble in hot water, sparingly, however, in cold water): *lead pyruvate*, $[C_7H_6Br\cdot NH\cdot N:CMeCO_2]_2Pb$, a pale yellow precipitate.

The effect of heat on the potassium and lead salts is to furnish potassium or lead bromide as well as basic and acidic or phenolic decomposition products. The reactions are being further examined.

***3. "Researches on the terpenes. I. On the oxidation of fenchene." By John Addyman Gardner and George Bertram Cockburn.**

The authors give an account of their method of producing fenchene from fenchone, the oxidation products of fenchene, and pinene hydrochloride.

Fenchone, b. p. 191—192°, m. p. 6°, specific rotatory power $[\alpha]=+61°\ 58'$, was reduced to fenchyl alcohol by a modification of Wallach's method, using amyl alcohol and sodium instead of ethyl alcohol and sodium. It was obtained in hard, white crystals, m. p. 45°, specific rotatory power $[\alpha]=-13°\ 38'$.

The fenchyl alcohol was converted into fenchyl chloride by the action of phosphorus pentachloride, and this into fenchene by saponification with aniline. The bulk of the fenchene thus obtained distilled for the most part between 150° and 156°, several degrees lower than that described by Wallach, which boiled between 158° and 160°. A fraction 152—154° was shown by combustion to have the formula $C_{10}H_{16}$. Its specific gravity was 0·8667 at 18° and specific rotatory power $[\alpha]=$

$-6°\ 46'$ (not in solution). The specific gravity of Wallach's hydrocarbon was 0·864 at 20° and it was optically inactive.

As a bye-product in the action of fenchyl chloride on aniline, the authors obtained a black oil, not volatile in steam. This substance did not solidify on standing, but on distillation under reduced pressure came over for the most part at 171—173° at 13 mm. pressure. It was a pale yellow, thick, viscous oil which turned black on exposure to air. Analysis showed it to have the composition $C_{10}H_{17}NHC_6H_5$. On treatment with acetyl chloride, it yielded a thick, viscous oil of the composition $C_{10}H_{17}N(Ph)COMe$.

Fenchene was oxidised by heating it on the water bath with nitric acid (1 nitric acid : 1 water). When the oxidation was complete the liquid was distilled in steam, when some acetic acid was obtained. The residue was then evaporated to small bulk, and on standing crystals of cis-camphopyric acid separated out. After the removal of these crystals, the oily mother liquors were eventually distilled in vacuo. An acid oil and a neutral solid distilled over; these were separated by means of sodium carbonate, and the solid crystallised from alcohol. It proved to be camphopyric anhydride, m. p. 178°. The yield of camphopyric acid obtained in these experiments was about 20 per cent.

Turpentine hydrochloride was heated on the water bath with nitric acid (2 nitric : 1 water). The oxidation was exceedingly slow, but after about 10 days the bulk of the hydrochloride had disappeared. The greater part of the acid was then distilled and contained a considerable proportion of acetic acid. The residue was then evaporated to complete dryness, dissolved in ether and the ethereal solution extracted with sodium carbonate.

The acids extracted by the alkali were converted into insoluble lead salts. The lead salts were decomposed by sulphuric acid and extracted with ether. On evaporating the ether, an oil was obtained which on standing deposited crystals of camphoric acid; the purified acid melted at 202—203°, and its anhydride at 217°.

The oil left after separation of these crystals was distilled in a vacuum; an oil distilled over between 120—130°, a smaller portion at 130—150°, and a considerable amount at 180—200°, which solidified on standing. This latter portion was purified by sublimation and crystallisation from alcohol, and proved to be camphopyric anhydride, m. p. 178°.

The yield of camphoric acid from 300 grams of turpentine hydrochloride was 18 grams, and of camphopyric anhydride 8—9 grams. The authors were unable to isolate any camphoic acid.

4. **"The action of alkalis on amides." By Julius B. Cohen, Ph.D., and Charles E. Brittain, B.Sc.**

The authors have succeeded in preparing a series of compounds of the general formula $R'NH{\cdot}C_2H_3O{\cdot}NaOH$ and $R'NHC_2H_3O{\cdot}KOH$, by the action of the caustic alkalis on amides under certain conditions. These substances are analogous in their mode of formation and in properties to the alcoholates previously described (Cohen and Archdeacon, Trans., 1896, **69**, 9), and probably possess a similar constitution, which may be expressed by the formula

$$\begin{array}{l} R'\text{—}N\text{—}Na \\ Me\cdot\ C\!<\!\begin{array}{l}OH. \\ OH\end{array}\end{array}$$

5. **"The formation of monomethylaniline from dimethylaniline." By Julius B. Cohen, Ph.D., and Harry T. Calvert, B.Sc.**

When phenylnitrocarbinol (Trans., 1897, **71**, 1050) acts on dimethylaniline, a violent reaction occurs and the dimethylaniline is converted into nitrosomethylaniline, and at the same time nitrogen is evolved and benzylalcohol and benzaldehyde are formed. As phenylnitrocarbinol readily evolves nitrous fumes on standing and reacts in some cases like nitrous acid, this result suggested the possibility of a similar reaction occurring when nitrogen trioxide acts upon dimethylaniline. The latter action is, however, entirely distinct from that of phenylnitrocarbinol or nitrous acid, and will form the subject of a future communication.

6. **"Note on the aluminium-mercury couple." By Julius Cohen, Ph.D., and Harry T. Calvert, B.Sc.**

The authors find that when aluminium is amalgamated with mercuric chloride, a small quantity of chlorine is retained by the aluminium and is probably present as oxychloride. The presence of the chlorine first became evident in the process of reducing a nitro-compound in neutral solution, when, instead of the free base, the hydrochloride was formed.

7. **"Action of chloroform and alkaline hydroxides on the nitrobenzoic acids." By Walter J. Elliott, M.A.**

The author finds that the meta- and para-acids are reduced to the corresponding azoxy-acids, while the ortho-acid is not appreciably affected.

ADDITIONS TO THE LIBRARY.

I. *By Purchase.*

Bancroft, W. D. The Phase Rule. Pp. viii + 255. New York 1897.

Berthelot, M. Thermochimie. Tome I. Les lois numériques. Pp. xvii + 737. Tome II. Les Données expérimentales. Pp. 878. Paris 1897.

Les Actualités Chimiques. Revue des progrès de la Chimie pure et appliquée, publiée sous la direction de M. Charles Friedel. Rédacteur G. F. Jaubert. Pp. 341. Paris 1896.

Donations.

Garrett, F. C., and Harden, A. An Elementary Course of Practical Organic Chemistry. Pp. viii + 72. London 1897.

From the Authors.

Wade, John. Introduction to the Study of Organic Chemistry. Pp. xvi + 460. London 1898. From the Author.

At the next Meeting, on Thursday, February 3rd, the following Papers will be received. The author of that marked with an asterisk has announced his intention of being present.

"On the dissociation of potassium platinichloride in dilute solution, and the production of platinum monochloride. By E. Sonstadt.

"Effect of the mono-, di-, and tri-chloracetyl groups on the rotatory power of methylic and ethylic glycerates and tartrates." By Percy Frankland, F.R.S., and Thomas Stewart Patterson, Ph.D.

"The rotation of ethylic and methylic di-monochloracetyltartrates." By Percy Frankland, F.R.S., and Andrew Turnbull, Ph.D.

* "The volumetric estimation of sodium." By H. J. H. Fenton, M.A.

CERTIFICATES OF CANDIDATES FOR ELECTION.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on February 17th.

Allhusen, Ernest Lionel,

Geological Survey Offices, Perth, West Australia.

Geologist. Bachelor of Science (University of Durham), Honours in Chemistry and Geology. For some years Chemist to the Imitio Alkali Co., Ltd.

P. Phillips Bedson.	R. Greig Smith.
Saville Shaw.	F. E. Allhusen.
F. C. Garrett.	John M. Thomson.

Bailey, William Martin,

13, Green Lane Road, New Evington, Leicester.

Teacher of Science. Honours Practical Chemistry, 1st Class; Advanced Inorganic Theoretical, 1st Class; Advanced Inorganic Practical, 1st Class; Pass in Chemistry at Inter. Arts Exam., Royal Univ. Dublin. Pass in Chemistry at London Inter. Science.

Edgar E. Horwill.	E. Masters.
W. B. Hards.	*W. H. Lewis.*

Duncan T. Richards.

Brittain, Charles Edward,

11, Highfield, Scarborough.

Research Student in Chemistry at the Yorkshire College, Leeds, 1893–6. Student of Chemistry at Yorkshire College; Graduated B.Sc., Honours in Chemistry, Victoria University, 1896–7. Studied under Prof. Fittig in Strassburg. Last three months Research Student at Yorkshire College. Results of work are to be published shortly.

Arthur Smithells.	Reginald B. Brown.
Julius B. Cohen.	John McCrae.

Herbert Ingle.

Brooks, Cecil Joslin, A.I.C.,

24, Wood Street, Woolwich.

Metallurgical Chemist. Educated at King's College during the

Sessions 1892—1895. For some time as Assistant in a Chemical Laboratory. Has been engaged during the last two years as Chemist in Cement Works and in Lead Smelting and Desilverising Works.

John M. Thomson. Patrick H. Kirkaldy.
Herbert Jackson. William H. Sodeau.
Jas. K. Burbridge.

Bull, Benjamin Samuel,

49, Devonshire Road, Greenwich, S.E.

Chemist to Messrs. Wilkinson, Heywood and Clarke. M.A. and B.Sc. (University of New Zealand); Ph.D. (Munich), A.I.C.

Henry E. Armstrong. Sidney Williamson.
F. Stanley Kipping. Gerald T. Moody.
William J. Pope.

Burge, Charles Henry,

Iddesleigh, Crescent Road, Kingston Hill, S.W.

Analyst, Government Laboratory, W.C. Student at Royal College of Chemistry. Thirty years at the Laboratory, Somerset House. Fellow of the Institute of Chemistry.

T. E. Thorpe. E. Grant Hooper.
R. Bannister. C. Proctor.
H. J. Helm. J. H. Robbins.
J. Woodward.

Caldecott, William Arthur,

Box 1891, Rand Central Ore Reduction Co., Ltd., Johannesburg, South African Republic.

Metallurgical Chemist. B.A. (Cape of Good Hope University). Member Soc. of Chem. Ind. and of Chemical and Metallurgical Soc. of S. Africa. Author of "Smelting and Refining of Cyanide Bullion" (Jan., 1897, S.C.I.), and "Relative Efficiency of Strong and Weak Cyanide Solutions for Dissolving Gold" (Proc. C. and M. of S. A.). Engaged for seven years in actual working of cyanide process and research connected therewith.

William Crookes. Alfred James.
R. R. Tatlock. H. T. Durant.
John S. McArthur.

Cannon, Matthew J.

101, The Chase, Clapham Common, S.W.

Analytical Chemist. Received a private training under my father, Matthew Cannon, F.C.S., conjointly with study at various Colleges and Institutions and also as a pupil of H. S. Carpenter, F.I.C., F.C.S. Have been engaged for 12 years as Assistant Chemist in the Acetic Acid Works

of Messrs. Beaufoy & Co., and for several years (1888—1891) I have been Demonstrator in the Laboratory (evening) of Onslow College, Chelsea. Recently studied Brewing Chemistry under John Heron, B.E., F.I.C., F.C.S., and have obtained highest place and silver medals both in the Ordinary and Honours Stage of the City and Guilds Examination in Brewing.

Matthew Cannon.	C. A. Mitchell.
John Wilson.	Walter J. Sykes.
John Heron.	*Otto Hehner.*

Cooper, Albert John Bullen,
Grimston Lawn, Ealing, W.

Student. Studied Theoretical and Practical Chemistry at the Pharmaceutical Society under Prof. Dunstan and Dr. Attfield during the Sessions 1891—1893. Worked at Practical Chemistry for one Session in l'École Supérieure de Pharmacie de Paris. From 1895 have been attending Classes in Mathematics, Physics, Physiology and Analytical Chemistry in King's College, London.

Wyndham R. Dunstan.	Herbert Jackson.
John Attfield.	Patrick H. Kirkaldy.
John M. Thomson.	W. D. Halliburton.

Cooper, John.
20, Derwentwater Road, Gateshead-on-Tyne.

Assistant Demonstrator in Chemistry. Student-Demonstrator Durham College of Science. Student of above College for four years. Formerly Assistant Chemist Messrs. Cochrane & Co., Iron Works, Middlesbrough. B.Sc., University of Durham. Friere Marreco Medallist in Chemistry, University of Durham.

P. Phillips Bedson.	R. Greig Smith.
F. C. Garrett.	Saville Shaw.

Wm. McConnell, Jun.

Cooper, William Ranson, M.A., B.Sc., A.I.C.,
87, Upper Tulse Hill, S.W.

Electro-Chemist. Studied Chemistry at King's College, London. Obtained the B.Sc. Degree at the Royal University of Ireland in Chemistry and Experimental Physics. Electro-chemical Assistant to Mr. James Swinburne during the last two years. Associate of the Institute of Chemistry.

John M. Thomson.	Herbert Jackson.
Henry E. Armstrong.	Patrick H. Kirkaldy.
James Swinburne.	Gerald T. Moody.

William H. Sodeau.

Cowling, Frederick,

Clay Cross, nr. Chesterfield.

Head Master, Technical Schools. Lecturer on Chemistry and Physics in the above schools. Sometime Demonstrator in Chemistry to Leicestershire County Council Technical Education Committee.

Edward Francis. G. H. Major.
George Young. *Frank Clowes.*
J. J. Sudborough.

Dodd, Frederick Robertson,

1, Wesley Street, Liverpool.

Analytical Chemist. Two years Student of Chemistry at Anderson's College, Glasgow. Six months in the Laboratory of Messrs. Wm. Brown, Sons & Co., Oil Merchants. Five and a half years Assistant to A. Smetham, Esq., F.I.C., F.C.S., &c. Associate of the Institute of Chemistry by examination (July, 1895).

Alfred Smetham. William Ralston.
John B. Ashworth. *G. G. Henderson.*
James Robson. *Matthew A. Parker.*
Thomas Gray. *A. Humboldt Sexton.*

Dootson, Frederick William, M.A.

Bryn, Glisson Road, Cambridge.

Assistant Demonstrator in the University Chem. Lab., Camb. Joint Author with W. J. Sell, M.A., of a paper on Citrazinic Acid (Journal of the Society, 1897).

G. D. Liveing. W. J. Sell.
James Dewar. H. J. H. Fenton.
Alexander Scott.

Edwards, Wilbraham Tollemache Arthur,

Reduit, Mauritius.

Analytical and Consulting Chemist. Member of the Royal Agricultural College, Cirencester. Fellow of the Institute of Chemistry of Great Britain. Assistant Director of the Agricultural Experiment Station (since Jan. 1893), Reduit, Mauritius.

L. Ehrmann. John A. R. Newlands.
Edward Kinch. B. E. R. Newlands.
Bernard Dyer. *Thos. Tyrer.*
Boverton Redwood.

Fuerst, Jules,

23, Marlboro' Road, N.W.

Merchant. Fellow of the Royal Photographic Society. Author of

Book on Modern Developers. Lecturer on Orthochromatic and Animated Photography.

John Moss. David Howard.
Thos. Tyrer. T. Donald Watson.
A. F. Fuerst.

Gilderdale, Frederick,

3, Havelock Street, Newcastle-on-Tyne.

Chemist and Analyst. Chemist and Analyst for John Ismay & Sons, Manufacturing Chemists, Newcastle-on-Tyne.

Thomas Tyrer. Jas. Baynes.
Francis Ransom. *John Pattinson.*
W. Watson Will. *T. Donald Watson.*

Gilles, William Setten,

"Coniston," Cedars Road, Beckenham, Kent.

Leathersellers' Company Research Fellow at Central Technical College. Associate of the City and Guilds Institute. Engaged in Research during past two years and Joint Author with Mr. F. F. Renwick of Notes in Chem. Soc. Proceedings.

Henry E. Armstrong. F. Stanley Kipping.
Gerald T. Moody. William J. Pope.
Sidney Williamson. R. L. Jenks.

Glaister, John,

4, Grafton Place, Grafton Square, Glasgow.

Professor of Forensic Medicine and Public Health, St. Mungo's College, Glasgow. M.D., Glasg.; F.F.P.S. Glasg.; L.R.C.S., Ed.; L.R.C.P., Ed.; D.P.H., Camb. Teacher of Public Health Laboratory Instruction in Chemical Analyses, &c., St. Mary's College, Glasgow, for ten years past, which is recognised for graduation by Universities of Oxford and Cambridge, and the Scottish Colleges. Examiner in Forensic Medicine and Toxicology to Royal Colleges of Physicians and Surgeons of Edinburgh and Faculty of Physicians and Surgeons of Glasgow for past fifteen years; Examiner for Diplomas in Public Health to same Colleges, with special reference to Laboratory work and analysis.

W. Ivison Macadam. R. R. Tatlock.
John Clark. James M'Cutcheon.
T. Rhymer Marshall.

Hills, Thomas Herbert,

6, Eliot Park, Blackheath.

Chemical Manufacturer. Studied Chemistry (Theoretical and Prac-

tical) with Prof. Graham. Student in Chemistry at Royal College of Science, Kensington, under Prof. T. E. Thorpe. At present Manager of Messrs. F. C. Hills & Co., Chemical Works, Deptford, and East Greenwich.

T. E. Thorpe. W. Palmer Wynne.
F. Napier Sutton. W. A. S. Calder.
E. C. Thompson.

Homfray, David,

6, Dartmouth Row, Greenwich, S.E.

Analytical Chemist. Bachelor of Science (London University). Fellow of the Institute of Chemistry.

C. T. Kingzett. William Ramsay.
H. B. Dixon. H. Wood Smith.
Robert Waterhouse.

McEwen, Atholl Francis,

43, Gilmore Road, Lewisham, S.E.

Metallurgical Chemist and Assayer. Nearly two years an Assistant in Laboratory of Incandescent Gas Light Co. For seven years Assistant to Edgar Jackson, Esq., F.I.C., A.R.S.M., &c. Went out to British Columbia on a three years' engagement, but just returned (owing to circumstances beyond control) after fifteen months' Mining work, with "Lillovet Fraser River and Cariboo Gold Fields."

W. Mackean. Horatio Ballantyne.
R. R. Tatlock. James Mactear.
Charles G. Cresswell.

Miller, John Edward,

Holmood, Patrington, Hull, Yorks.

Veterinary Surgeon. Member of the Royal College of Veterinary Surgeons, Studied Chemistry in Edinburgh: Official Inspector for the Board of Agriculture.

W. H. Coates. M. D. Penney.
Jas. Baynes. *George Robertson.*
William Fowler.

Mills, William Hobson,

Jesus College, Cambridge.

Student of Chemistry. B.A., late Scholar of Jesus College, Cambridge, First Class Natural Sciences Tripos, Part I. and Part II., working at organic research.

G. D. Liveing. W. J. Sell.
Thomas H. Easterfield. H. J. H. Fenton.
George Dixon.

Morgan, Gilbert Thomas,

35A, Russell Road, Kensington, W.

Assistant Demonstrator, Royal College of Science, London, S.W. Student in Chemistry, Technical College, Finsbury, 1886—89. Joint author with Professor Meldola, F.R.S., "On the constitution of Azo- and Diazo-derivatives," J.C.S., vol. lv. "Contributions to the Chemistry of the Azonaphthols," J.C.S., vol. lv. Research and Works Chemist, Read, Holliday & Sons, Limited, Huddersfield. Associate in Chemistry Royal College of Science, 1896. First Class Honours in Chemistry, B.Sc., London, 1896.

William A. Tilden. R. Meldola.
W. Palmer Wynne. Henry E. Roscoe.
Chapman Jones.

Moss, William Edward,

Burnthwaite, Bolton, Lancashire.

Millard Scholar in Natural Science at Trinity College, Oxford. Engaged in the study of Chemistry, and generally interested in its progress.

Richard J. Moss. D. H. Nagel.
Percy Elford. E. G. J. Hartley.
J. E. Marsh. A. E. Tutton.

Poole, Herman,

323, W. 34th Street, New York City.

Manufacturing and Technical Chemist. Head Chemist, Grosselli Chem. Co., Cleveland, Ohio, 4 years, 1887—91. Inventor of Ferroid. Originator of the Poole Ointments. Inventor of Poole process of treating Aluminum Phosphate Rock. Chemist to Board of Health, Buffalo, N.Y., 1878. Translator of Scheurer-Kestner's "Pouvoir Calorifique de Combustibles." Translator for the *American Gaslight Journal*, N.Y. City. Author of paper on determination of fat and casein in fæces, read at Am. Chem. Soc. 1897 meeting. Manufacturer of purifying material for gas works. Long and varied experience in Analytical, Metallurgical, and Manufacturing Chemistry.

Peter T. Austen. R. C. Woodcock.
James H. Stebbins, Jun. *E. G. Love.*
Wm. Jay Schieffelin.

Pope, Thomas Henry,

South Street, Ponders End.

Associate of the City and Guilds Institute. Assistant in the Chemical Laboratory of Robert Mond, Esq.

Henry E. Armstrong. William J. Pope.
Gerald T. Moody. Sidney Williamson.
Arthur R. Ling.

Reid, James Brown,

6, Southfield Terrace, Skipton.

Chemist and Brewer. Student of Chemistry, Technical College, Glasgow.

G. G. Henderson.	William Ralston.
James Robson.	Matthew A. Parker.
Thomas Gray.	A. Humboldt Sexton.

Renwick, Frank Forster,

Glengall, Woodford Green, Essex.

Chemical Student at the Central Technical College, South Kensington. Holder of a Research Fellowship of the Leathersellers' Company. Joint author with Mr. W. S. Gilles of contributions to the Proceedings of the Chemical Society:—Proc. Chem. Soc., 1897, p. 64, and 1897, No. 92. A.C.G.I.

Henry E. Armstrong.	William J. Pope.
F. Stanley Kipping.	Arthur Lapworth.
Gerald T. Moody.	*R. L. Jenks.*

Reynolds, William Colebrook,

64, Lydford Road, Paddington, W.

Student. Studied Chemistry at Owens College (1890—1). Gained a National Scholarship, and in 1897 became an Associate of the Royal College of Science in Chemistry. Passed Inter. Sc. (London) with 1st Class Honours in Chemistry. Now working in the Research Laboratory of the Royal Coll. Sc.

William A. Tilden.	H. B. Dixon.
W. Palmer Wynne.	Chapman Jones.

M. O. Forster.

Richards, William,

Old Elvet, Durham.

Member of Durham University. On Organising Staff of Education Department of County Council. During the past three years, I have taken the course prescribed for undergraduates in Science of the Durham University. In the final examination for the title of A.Sc. (which examination I passed in June last), I took Chemistry, Inorganic and Organic, as one of the subjects. I have had experience in teaching Chemistry and Physics.

P. Phillips Bedson.	F. C. Garrett.
R. Greig Smith.	Saville Shaw.

G. P. Dodds.

Sayer, Harold Charles,

Devon Villa, Summerhill Road, Dartford.

Analyst in the Laboratory of Messrs. Burroughs, Wellcome and Co.'s Works, Dartford. Associate of the City and Guilds of London Institute. For four years a student in the Central Technical College.

Henry E. Armstrong.	William J. Pope.
David Johnson.	Sidney Williamson.
Gerald T. Moody.	F. Stanley Kipping.

Walker, Andrew Jamieson, B.A.,

Kilycadden, Killygordon, Co. Donegal.

Student in the Chemical Laboratory of the Univ. of Heidelberg. Lately Demonstrator of Chem. in Queen's College, Galway. For six years student of Chemistry and Physics in Queen's College, Galway, 1890—96. Senior scholar in Chemistry, 1893—4. Demonstrator, 1893—96. B.A. Royal Univ. of Ireland in Chem. and Physics. At present engaged in an investigation, suggested by the late Prof. Victor Meyer, on the constitution of the (*o*) and (*p*) Cyanophenols, in the Univ. of Heidelberg.

A. Senier.	*Maxwell Simpson.*
E. A. Letts.	*J. Emerson Reynolds.*
H. Lloyd Snape.	*W. N. Hartley.*

Weissmüller, Ernest Charles,

30, Pepys Road South, New Cross, London, S.E.

Junior Assistant Chemist. Studied for three years at City and Guilds Technical College, Finsbury, where certificate was gained. Afterwards Assistant Chemist to Mr. Cowper-Coles, 39, Victoria Street, Westminster, in Electro-Metallurgical investigations. Since October 1896, Junior Assistant Chemist to Scientific Dept. of the Imperial Institute, under Prof. W. R. Dunstan.

Wyndham R. Dunstan.	A. G. Bloxam.
R. Meldola.	Francis H. Carr.

R. L. Jenks.

Approved by Council under Bye-Law I. (3).

Don, John R., D.Sc., M.A.,

Waitaki Boys' High School, Oamaru, New Zealand.

Rector of the Boys' High School. Seven years Lecturer on Chemistry at the Dunedin Technical College, N.Z. Lecturer on General and Chemical Geology at the Otago University School of Mines, Dunedin.

A. Vernon Harcourt.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 10/2/1898.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 188. Session 1897–8.

February 3rd, 1898. Professor Dewar, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. Charles Baskerville, North Carolina University, Chapel Hill, North Carolina; Alfred Campion, 637, Alexandra Parade, Dennistown, Glasgow; Robert Martin Caven, University College, Nottingham; F. Hudson-Cox, 67, Surrey Street, Sheffield; John Arnold Fleming, Britannia Pottery, Glasgow; Harry Pearson Hodgson, Caldew Bank, Cummersdale, Carlisle; Edwin Charles Jee, 45, Pepys Road, New Cross, S.E.; Edward Jones, Vine Cottage, Tudor Road, Kingston-on-Thames; Walter Ratcliffe, 21, Mawdsley Street, Bolton; Henry Somerville 33, Vincent Square, S.W.; Harry St. John, Thornfield, Sunderland.

Of the following papers those marked * were read :—

*8. "The volumetric estimation of sodium." By H. J. H. Fenton, M.A.

Dihydroxytartaric acid, in presence of dilute sulphuric acid, is readily oxidised by potassium permanganate at the ordinary temperature, the reaction affording a very convenient method for the estimation of the acid or its salts. A method has been devised for the quantitative estimation of sodium based upon this relation and upon the sparing solubility of sodium dihydroxytartrate. The solubility of the sodium salt at 0° is shown to be extremely small, and in presence of excess of a dihydroxytartrate is practically negligible.

The substance to be examined, in concentrated neutral solution, is mixed with excess of potassium dihydroxytartrate and the mixture is kept at 0° for half an hour. The precipitated sodium salt is washed

with a little ice-cold water, dissolved in excess of dilute sulphuric acid and titrated with potassium permanganate.

The results obtained with sodium sulphate, chloride, nitrate, acetate, and with rochelle salt, are accurate within 0·3 per cent. The presence of magnesium does not interfere with the accuracy of the results, but ammonium salts, if present in excess, lead to low results. Full details for working the process are given in the paper.

The potassium and ammonium salts of dihydroxytartaric acid have been prepared and examined, and, together with other derivatives of the acid, will be described in a future communication.

DISCUSSION.

Mr. HEHNER said that analysts would welcome the method. It was remarkable that sodium, the most widely distributed element, had hitherto been without a direct method of quantitative estimation. He would suggest that the process should be conducted gravimetrically.

Mr. NEWLANDS mentioned that he had at one time been accustomed to determine sodium as acid oxalate with approximate accuracy by titration either before or after incineration.

Dr. LAWSON asked how Mr. Fenton's method for the production of dioxytartaric acid compared, as regards yield, with that usually employed. The sodium salt was of technical importance in the preparation of a valuable dye-stuff, and it would be of interest to know whether the results were comparable with those obtained by decomposing nitrotartaric acid.

Mr. FENTON, in reply, said that he had suggested in the paper that the process might be conducted gravimetrically, but he considered that the volumetric method would find most favour. He had experimented with other sparingly soluble sodium salts, but did not think that any could nearly compare with the dihydroxytartrate as regards insolubility. In reply to Dr. Lawson, he said that the process possessed many advantages as compared with the usual method of preparing the sodium salt from nitrotartaric acid.

***9. "The atomic weight of boron." By F. P. Armitage.**

The determination of the water of crystallisation was the method used. The values for the ratio $Na_2B_4O_7 : H_2O$ obtained by previous workers are not sufficiently concordant to allow of the values for the atomic weight of boron, calculated from them, being regarded as very trustworthy. The discrepancies are probably to be traced to the slight efflorescence which occurs during the preliminary drying of the crystals of borax. A new method of drying was consequently applied, the borax being washed with alcohol and ether successively, and the ether expelled by exposure for 6 hours in a vacuum. A given weight

of the dry crystals was dehydrated in a stream of air, the final traces of water being expelled by fusion over the Bunsen burner and not over the blowpipe.

In a series of six experiments, the greatest difference in the percentage value for the water of crystallisation was 0·413, and the mean atomic weight of the element as calculated from these values 10·959, a number differing by 0·006 from that recently obtained by Ramsay and Aston in their experiments on the distillation of sodium diborate with hydrochloric acid and methyl alcohol.

Certain results are also given in which the method of titration (*cf.* Rimbach, *Ber.*, 1893, **26**, 164) is applied with a view of ascertaining the possible degree of its accuracy. Thus, a given weight of fused borax was dissolved in water and titrated with dilute sulphuric acid, the strength of which had been determined (i) by titration with solution of pure soda of known strength, (ii) as barium sulphate. The value 10·928 was obtained for the atomic weight of boron as a mean of two experiments performed by this method.

Discussion.

Mr. Veley said that methods of determination of atomic weights based upon the elimination of water from a crystalline salt presented the difficulties, firstly, of the mechanical inclusion of water within the walls of the crystals, however fine, and, secondly, of the possible efflorescence and deliquescence of such salts. These difficulties, as also that of the intumescence of the anhydrous salt, when heated with the blowpipe, induced Ramsay and Aston to reject this method. It appeared that the author had overcome these difficulties to a great extent by removing the adherent water by washing with absolute alcohol and subsequently with ether, which was pumped off, as also by heating the anhydrous salt only at a temperature obtained by the Bunsen burner, and not at that of the blowpipe, when loss occurred either on account of the volatilisation or the decomposition of the borax. The experiments of the author also showed that the method of determining the atomic weight, proposed by Rimbach, though not of the degree of exactitude necessary for such determinations, was probably more accurate for the purpose of acidimetry than that of sodium carbonate, which was not readily obtained of the composition required by its molecular formula.

Mr. Groves asked whether the volatilisation observed when the crucible was heated in the blowpipe flame might not be due to the action of water vapour and carbonic anhydride which would diffuse through the perforated cover.

Dr. Scott was astonished that any one now should attempt to determine atomic weights through calculations of the amount of

water of crystallisation contained in hydrated salts. The experiments of J. W. Mallet on ammonia alum and of many other experimenters had shown how unsatisfactory such determinations must always be. It was evident that as such salts produced a determinate vapour pressure of water depending on the temperature, if the air in which they were dried contained less than that amount the salt must lose water during its drying.

The PRESIDENT considered it superfluous to record weighings to six places and the atomic weight to three places of decimals, having regard to the method adopted. With reference to the process employed by the author in drying the borax, he failed to understand why, if borax is an efflorescent salt, it loses no water of hydration when washed with absolute alcohol. He suggested that in investigating this point the influence of time should be taken into account.

Mr. ARMITAGE, in reply, said that he had not examined the sublimate formed on the lid of the crucible when ignited with the blowpipe, as his object was to show merely that a loss of weight would occur if this method is adopted. The standard of atomic weight taken was oxygen = 16. The time occupied for each washing by absolute alcohol was 3—4 minutes.

***10. "Rate of escape of ammonia from aqueous solution." By E. P. Perman, D.Sc.**

If a current of air is drawn through a dilute aqueous solution of ammonia at a uniform rate, the amount of ammonia q in solution when a volume V of air has passed through the solution, is accurately represented by the equation $\log q = a - bV$, a and b being constants. The volume of air was measured by a meter.

The equation does not express the results given by a concentrated solution; the solution used in most of the experiments contained 70 grams of ammonia per litre.

A number of experiments, conducted at different temperatures, prove that the logarithmic formula holds good between 0° and 46°; it was also found to hold good when the pressure was varied.

The value of b is a measure of the rate of escape of the gas from the solution under any specified conditions; such values were obtained at various temperatures, and a simple connection was found between b and temperature $t°$, viz., $\log b = \alpha + \beta t$, α and β being constants. Combining the two logarithmic equations,

$$\log q = a - y, \text{ if } \log y = \alpha + \log V + \beta t.$$

From this expression the amount of ammonia left in a solution after a certain volume of air has been drawn through it can be at once calculated, provided that, at the beginning of the aspiration, the strength of the solution was not much greater than that mentioned above.

Discussion.

The President remarked that the subject investigated by the author was a very complicated one. He thought that the variations in the tension of the ammonia solution used in the experiments should be determined, as a valuable addition to the paper. It was probable that the results would be expressed by the equation—log $p = A - B/T$— where A and B are constants and T is the absolute temperature, which was applicable to many similar cases.

Dr. Perman, in reply to a question by Mr. Groves, stated that the conditions of volatilisation of ammonia from the solution had been varied by using flasks of different capacities and tubes of different diameters. In reply to Dr. Wilderman, he said that he considered that his results confirmed Henry's law for ammonia in dilute solution. In reply to the President, the author said he had found approximately the vapour-pressure of the ammonia solution used in most of the experiments at a temperature of 20°; it was about 70 mm. although he had not found the vapour-pressure of solutions of different strengths, but intended to do so. He regarded the method of expressing the results given in his paper as the most convenient for the present, though as yet it was only empirical.

11. "On the dissociation of potassium platinichloride in dilute solution: and the production of platinum monochloride." By E. Sonstadt.

A solution of potassium platinichloride in 1000 parts of water undergoes no sensible change on heating for an hour or two. But a solution in 10,000 parts of water becomes turbid almost immediately on heating, and the turbidity increases until, after some hours, the liquid becomes nearly opaque. On continuing the heating for some days, water being added from time to time to maintain the bulk, a sediment forms and the liquid partially clears. By increasing the quantity of water during the heating, the clearance is facilitated. The reactions that take place are, first, the dissociation of the potassium platinichloride;

$$(1)\ K_2PtCl_6 = 2KCl + PtCl_4,$$

and then the decomposition of the platinic chloride, with formation of platinum monochloride (PtCl or Pt_2Cl_2) hydrochloric acid, and hydrogen peroxide, thus:

$$(2)\ 2PtCl_4 + 6H_2O = 2PtCl + 6HCl + 3H_2O_2.$$

The yellow, non-crystalline precipitate of hydrated platinum monochloride is difficult to collect, for it passes through the filter until the pores are clogged, and then the filtration is exceedingly slow. The precipitate should not be dried on the filter, but washed off, as far as

possible, into a dish, and the water evaporated. When dried on the water bath, the salt is brown; it still retains water, the last traces of which can scarcely be expelled before incipient decomposition begins; the anhydrous salt is black, or nearly so.

The clear filtrate, when concentrated, is strongly acid, and on drying and dissolving the residue in a little water, potassium chloride may be crystallised out. There is also a small proportion of potassium platinichloride, which may be either a portion of the original salt that has escaped decomposition, or may have been formed by a reverse action due to solution of the monochloride in the hydrochloric acid set free as described, in presence of hydrogen peroxide and air.

The hydrated salt, when treated on the water bath with strong soda solution, turns brown, and dissolves to a slight extent. But the brown residue is only partially dehydrated, and recovers its original colour after washing and exposure. The soda solution deposits the unchanged salt on dilution and long exposure to the air. It dissolves readily in hydrochloric acid; slightly in hot dilute sulphuric acid, apparently without decomposition; in moderately dilute nitric acid, used in large proportion, it dissolves to a deep brown liquid, which, evaporated to dryness on the water bath until no acid odour is perceptible, leaves a dark brown residue. This dissolves in hot water to a clear, dark brown liquid, which, on further heating, suddenly deposits the whole of the original salt, less any impurities present, which remain in the solution. The precipitate, when collected on a filter, is deeper coloured than before, being of an orange tint. The filtrate is free from platinum; but on continued washing with water, the salt dissolves slightly, and the filtered liquid becomes clouded.

Advantage was taken of this process of purification to obtain the monochloride for analysis. An attempt to analyse about 0·1 gram of the salt partially failed, owing to the presence of impurities taken up from the enormous proportion of distilled water used in its preparation. The monochloride, purified as described, was washed into a dish, and after drying on the water bath, was transferred to a small porcelain crucible. The salt weighed 0·2575 gram. The crucible was cautiously heated, with frequent application of the cold lid. Traces of nitric acid came off as well as water. When moisture ceased to be given off, the salt weighed 0·2315 gram. It was then more strongly heated, when chlorine came off and a final trace of water. The heat was then raised until the decomposition was complete. The platinum obtained weighed 0·1945 gram, which corresponds to 0·229 PtCl, a result which may be considered fairly satisfactory.

It might be supposed that platinic chloride itself, instead of dissociated from potassium chloride as in the described process, would be preferable, when it is desired to obtain platinum monochloride.

But the presence of free acid in the best-dried specimens of platinic chloride renders it unfit for the purpose. A specially dried specimen of platinic chloride dissolved in 10,000 parts of water gave a barely perceptible reaction. With 15,000 parts of water, after heating for some hours, the liquid became turbid, and gave a slight deposit, but not equivalent to that obtainable from a corresponding solution of potassium platinichloride. If, however, a solution of platinic chloride be evaporated on the water bath with nitric acid, the residue dissolved in water, and the solution evaporated again two or three times, the platinic chloride is not appreciably decomposed, but retains a little nitric acid instead of the hydrochloric acid with which it is otherwise associated. A solution of platinic chloride thus prepared, heated in 5,000 parts of water, gives a distinct turbidity, but the reaction is more nearly complete with double that proportion of water. The precipitate differs slightly in its properties from that obtained from the potassium salt; it is of a deeper tint, and is but slightly soluble in nitric acid. When treated with nitric acid and the solution evaporated over the undissolved portion, a weak solution only is obtained on adding water, which, on concentrating, deposits the salt, but not instantaneously. After evaporating the aqueous solution, the hydrate of platinum monochloride is insoluble in water, except, as in the former case, on continued washing. A specimen of the hydrate thus obtained weighed after drying on the water-bath, 0·1700 gram; when anhydrous, it weighed 0·1549 gram, and after expulsion of the chlorine by ignition 0·1316 gram of platinum remained. Theory requires from this quantity of platinum 0·1552 gram PtCl.

The potassium platinichloride used in the experiments had been several times recrystallised, and was perfectly free from acid. The yield of platinum monochloride was about five-eighths of that theoretically obtainable.

The author has made some experiments with the view of directly proving the presence of hydrogen peroxide in the liquid, though, considering the conditions of dilution and temperature, the quantity present at any time must be exceedingly small—the total amount produced according to the equation, assuming the reaction to be complete, being in the proportion of from 1 : 100,000 to 1 : 150,000 to the liquid present. In a solution that had been heated for five days, the author, using the chromic acid and ether test, obtained a faint coloration, hardly visible except to an observer of great sensitiveness. The author then prepared a solution in about 15,000 parts of water of some very pure crystals of potassium platinichloride (a previous trial with a salt of only ordinary purity having failed), and heated the solution for several hours at a temperature slightly below 70°. There was only a slight turbidity, for the temperature was too low for good

progress. On testing the solution the next day, a faint, bluish tint in the ether was perceptible. That hydrochloric acid is a product of the reaction was proved as follows. A hot, strong solution of potassium platinichloride was poured into a large quantity of a nearly saturated solution of pure potassium chloride. The precipitated platinichloride was collected, well washed with water, and afterwards with alcohol, and dried on the water bath. A solution of about one part of this salt to 10,000 of water was heated for five days, the precipitate allowed to settle, and filtered off. A portion of the solution was concentrated in an open dish to about one-fifth of its bulk, and was then distilled. Silver nitrate added to the distillate gave a precipitate of silver chloride insoluble in nitric acid.

12. **"Effect of the mono-, di-, and tri-chloracetyl groups on the rotatory power of methylic and ethylic glycerates and tartrates." By Percy Frankland, F.R.S., and Thomas Stewart Patterson, Ph.D.**

With a view of ascertaining the rotatory effect of the halogens when attached at a point in the molecule remote from the asymmetric carbon-atom, the authors have introduced the mono-, di-, and tri-chloracetyl groups into the methylic and ethylic tartrates and glycerates. This was effected by acting in each case with the acid chloride on the ethereal tartrate and glycerate respectively. The acid chlorides were in all cases prepared by heating the halogen-substituted acetic acid with phosphoric anhydride in a current of hydrochloric acid. Two acidyl groups were in all cases introduced, excepting in that of trichloracetyl, of which only one equivalent could be made to substitute in methylic and ethylic tartrates, whilst two equivalents reacted with the corresponding glycerates.

The rotations were in all cases determined at several different temperatures so as to ascertain the influence of the latter.

The results are summarised in the following table:—

	$[\alpha]_D^{15°}$	$[\alpha]_D^{100°}$	
Methylic glycerate	−4·80°	−8·31°*	(calculated).
,, diacetylglycerate	−12·04	−19·24*	(calculated). [43—44°.
,, di-monochloracetylglycerate..	−12·91	−17·99	b.p. 197° (15 mm.); m.p.
,, di-dichloracetylglycerate.....	−13·96	−17·18	b. p. 207° (20 mm.).
,, di-trichloracetylglycerate ...	−14·20	−15·30	b. p. 199—200° (15 mm.).
Ethylic glycerate	−9·18	−12·55*	(calculated).
,, diacetylglycerate.....	−16·31	−23·09*	(calculated).
,, di-monochloracetylglycerate...	−16·80	−22·08	b. p. 198° (15 mm.).
,, di-dichloracetylglycerate	−18·20	−21·10	b. p. 203° (15 mm.).
,, di-trichloracetylglycerate	−18·70	−18·40	b. p. 202° (15 mm.).

* These values for $[\alpha]_D$ at 100° for methylic and ethylic glycerates and diacetylglycerates have been calculated from the data given in a paper by P. Frankland and MacGregor (Trans., 1894, **65**, 768).

	$[\alpha]_D^{20°}$*	$[\alpha]_D^{100°}$	
Methylic tartrate	+2·14°	+5·99°	m. p. 48°.
,, diacetyltartrate	— *	—	m. p. 103.
,, di-monochloracetyltartrate	−0·62	+2·57	b.p. 217° (18 mm.); m. p. 55.
,, di-dichloracetyltartrate	+11·9	+10·9	b.p. 220—221° (15 mm.); m.p.
,, mono-trichloracetyltartrate	+8·4	+10·15	m.p. 79—80°. [64—65°.
Ethylic tartrate	+7·66	+13·29	
,, diacetyltartrate	—†	—	m. p. 66·5°.
,, di-monochloracetyltartrate‡	+7·67	+11·81	b. p. 217° (15 mm.); m.p. 27°.
,, di-dichloracetyltartrate	+16·3	+17·08	b. p. 225° (15 mm.).
,, mono-trichloracetyltartrate	+15·5	+17·6	b. p. 185° (16 mm.).

Methylic and ethylic di-monochloracetyltartrates have also been prepared by Freundler (*Bull. soc. chim.*, 1895, [3], 13, 1055—1063), who only obtained them as liquids with the following rotatory powers:—

Methylic di-monochloracetyl tartrate $[\alpha]_D^{18°} = +3·5°$

Ethylic ,, ,, $[\alpha]_D^{18°} = +9·4°$

In consequence of this discrepancy between Freundler's results and those of the authors, these two compounds have been prepared again (see next abstract), with the result that the authors' figures have been confirmed.

13. "The rotation of ethylic and methylic di-monochloracetyltartrates." By Percy Frankland, F.R.S., and Andrew Turnbull, Ph.D.

The ethylic compound has been again twice prepared by the authors, using different proportions of monochloracetylchloride and ethylic tartrate:—

First preparation, $[\alpha]_D^{20°} = +7·90°$.

Second ,, $[\alpha]_D^{20°} = +7·76°$.

The substance subsequently crystallised (m. p. 27°), after which the rotation $[\alpha]_D^{20°} = +7·61°$ was found.

The methylic compound was also prepared, and again gave the m. p. 55°; the rotation was $[\alpha]_D^{20°} = -0·68°$.

Thus the results obtained with both compounds by one of the authors (see previous abstract) were confirmed, whilst additional evidence of their accuracy was afforded by the ethylic compound being obtained in the crystalline state.

Ethylic mono-monochloracetyltartrate in a state approaching purity was also prepared, and it was found to possess a considerably higher dextrorotation than the corresponding di-acidyl compound, thus $[\alpha]_D^{20°} = +11·44°$.

* $[\alpha]_D^{25°} = -15·1°$ (in absolute alcoholic solution).

† $\alpha_D = +5°$ ($t=25$, $l=1$).

‡ See next abstract.

It is, therefore, inferred that the higher figures obtained by Freundler may have been due to the presence of monacidyl compounds, and this is borne out by the lower densities and boiling points which he records.

ADDITIONS TO THE LIBRARY.

I. *By Purchase.*

Boyle. Some Considerations Touching the Usefulness of Experimental Naturall Philosophy. First Part: On its usefulness in reference to the minde of man. Pp. 127. Second Part: Of its usefulness to Physik. Pp. 417. Oxford 1663.

Campredon, L. Guide pratique du Chimiste Métallurgiste et de l'Essayeur. Pp. iv + 808. Paris 1898.

Du Clos. Observationes super aquis mineralibus Galliæ. Leiden 1685. One volume with:—

Lister, Martin. Thermarum ac Fontium Angliæ. Leiden 1686.

Nietzki, Rudolf. Chemie der Organischen Farbstoffe. Dritte vermehrte Auflage. Pp. x + 343. Berlin 1897.

II. *Donations.*

Bolas, Thomas. Glass Blowing and Working, for Amateurs, Experimentalists and Technicians. Pp. 212. London 1898.
From the Author.

Patents for Inventions, Abridgments of Specifications. Class I. Acids, Alkalies, Oxides, and Salts. Inorganic. Periods 1884—88. London 1896. From the Patent Office.

Royal Society, The Record of the. No. 1. 1897. Pp. vi + 224. London 1897. From the Royal Society.

Royal Society, Yearbook of the, 1896–97. No. 1. London 1897.
From the Royal Society.

Pamphlets.

Don, J. R. The Genesis of certain Auriferous Lodes. Pp. 105. Read before the American Institute of Mining Engineers. February, 1897. From the Author.

Headden, W. P. Some Products found in the Hearth of an old Furnace upon the dismantling of the Trethellan Tin Works, Truro, Cornwall. (Read before the Colorado Scientific Society, November, 1897).
From the Author.

Mallet, J. W. On the Solubility of Ammonia in Water at Temperatures below 0°C.

—— Note on a somewhat remarkable case of the rapid Polymerisation of Chloral. (Reprinted from the *American Chemical Journal*, vol. xix. 1897). From the Author.

Manch, R. Ueber die Löslichkeit von Alkaloiden, Glykosiden und Bitterstoffen in concentrieter wässriger Chloralhydratlösung und die Verwerthung des Chloralhydrats in der toxikologischen Analyse. Pp. 26. Strassburg 1897. From the Author.

Schaer, E. Arzneipflanzen als Fischgifte. Pp. 65. Strassburg. 1897. From the Author.

Speyers, C. L. Molecular Weights of some Carbon Compounds in Solution. (Reprinted from the *Journal of Physical Chemistry*, December, 1897). From the Author.

Symons, Brenton. A Geological Sketch of the Coolgardie Goldfields. Pp. 49. London, 1896. From the Author.

Woodward, H. B., F.R.S. A Memoir of Thomas Beesley, J.P., F.C.S. Warwick 1897. From the Author.

Zenetti, Paul. Mikrokrystallinische Niederschläge der Pikrinsäure mit Alkaloiden. Strassburg 1897. From the Author.

At the next meeting, on February 17th, there will be a ballot for the election of Fellows, and the following papers will be read.

"Observations on the influence of the silent discharge on atmospheric air." By W. A. Shenstone and W. T. Evans.

"Some lecture experiments." By J. Tudor Cundall, B.Sc.

"On the condensation of formaldehyde with ethylic malonate: and on cis- and trans-tetramethylenedicarboxylic acid." By E. Haworth and W. H. Perkin, junr., F.R.S.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 24/2/1898.

PROCEEDINGS
OF THE
CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 189. Session 1897–8.

February 17th, 1898. Professor Dewar, F.R.S., President, in the Chair.

Messrs. George F. Merson and Ernest H. Roberts were formally admitted Fellows of the Society.

STATEMENT BY THE COUNCIL.

The PRESIDENT said he was authorised by the Council to make the following statement to the Society :—

The following letter has been received by the Council :—

Letter received by the PRESIDENT *from* Messrs. HARDEN *and* HARTOG.

THE OWENS COLLEGE, MANCHESTER, *Jan. 26th*, 1898.

DEAR SIR,—We beg to acknowledge the receipt of your letter of the 22nd inst. with reference to the Memorial which we had the honour of transmitting to yourself as President, and to the Council, of the Chemical Society, and to offer you our thanks in the name of the Memorialists for the consideration which it has already received.

We desire to point out that although it was not expressly so stated in the Memorial, it was obviously the wish of the signatories, if the Council had not at present the power to propose an alteration of Bye-Law V. in the sense suggested, that it should take the steps necessary to obtain that power. We gratefully recognise, therefore, the further consideration which the Council is now giving to this aspect of the question.

Would it be possible for us to be informed if it is the intention of the Council to make a definite statement with regard to the questions

raised in sufficient time for the matter to be brought before the Anniversary Meeting for this year?

We are, dear Sir,

Your obedient servants,

ARTHUR HARDEN.
PHILIP HARTOG.

Professor JAMES DEWAR, F.R.S., &c., &c.,
President of the Chemical Society.

The following reply had been sent that evening:—

Answer of Council.

CHEMICAL SOCIETY,
BURLINGTON HOUSE, W.
Feb. 17, 1898.

DEAR SIRS,—The Council desire me to thank you for your letter of the 26th January.

Since the presentation of the Memorial and the receipt of your letter of the 16th December, the question of the Society applying for a Supplemental Charter to enable votes at General Meetings to be given by proxy has received the anxious consideration of the Council, and in view thereof the Council has taken further legal advice on the matter.

The Council has this evening directed the President to make an announcement to the Society, which will be printed in the next Proceedings.

I am, dear Sirs,

Your obedient servant,

JAMES DEWAR,
President.

Messrs. HARDEN and HARTOG.

Report of the Council.

"The Council has submitted the question of a Supplemental Charter for legal opinion. The following was the case submitted:—

Case for the Opinion of Counsel.

On the 6th December last Counsel advised the President and Council of the Chemical Society whether under the Charter of such Society they had power to alter the Bye-Laws so as to provide for the

Votes at General Meetings being given by proxy. The case then laid before Counsel and his opinion thereon are sent herewith.

The Memorial referred to in the case has now been presented to the President and Council. It was signed by over 500 Fellows or about one-quarter of the total number. A copy thereof is sent herewith.

Together with the Memorial a letter dated the 15th December 1897 was received from Mr. Arthur Harden and Mr. Philip Hartog a copy of which is also sent herewith.

Such letter contains the following passage.

> With reference to the substance of the Memorial we wish to make one statement. We are aware that in the Charter (on page 8 of the printed text) it is provided that "at all general "meetings and meetings of the Council the majority present "and having the right to vote thereat respectively shall de- "cide upon the matters propounded at such meetings" hence in order to render legal the change desired it would probably be necessary to obtain a Supplemental Charter allowing members not actually present at meetings to vote by means of balloting papers. It is in this connection material to point out that in order to obtain a revision of Bye-Laws precisely similar to that now desired by Fellows of our own Society a Supplemental Charter was quite recently obtained by the Institution of Civil Engineers.

It is upon the question of a Supplemental Charter that the opinion of Counsel is now desired.

Enquiries have been made with reference to the Supplemental Charter obtained by the Institution of Civil Engineers referred to in the above mentioned letter. Such Supplemental Charter was obtained in March 1896 and a printed copy thereof together with a copy of the original Charter and Bye-Laws of such Institution is sent herewith.

It appears that the circumstances under which that Supplemental Charter was granted were not analogous to the facts connected with the Chemical Society and it is questionable whether that case can be regarded as a precedent in favour of granting a Supplemental Charter to such Society provided the Society as a whole should decide to present a petition for one.

In the first place the members of the Institution of Civil Engineers were unanimous in desiring the change. In the present case it is believed that the Fellows are not unanimous on the question and it is not at present known whether even a majority desire the change.

Secondly the objects of the Chemical Society and of the Institution of Civil Engineers respectively are wholly different.

The object of the Chemical Society shortly stated is the general

advancement of Chemical Science by the holding of Meetings at which new discoveries are brought under discussion and the results made known to the public in a series of Transactions.

It is a purely scientific Society and in no sense professional and in this respect resembles rather the Royal Society the constitution of which requires the presence of Fellows at general meetings to enable them to vote.

The object of the Institution of Civil Engineers on the other hand is not merely for the general advancement of Mechanical Science it is "more particularly for promoting the acquisition of that species of "knowledge which constitutes the profession of a Civil Engineer." It holds examinations for the admission of persons desirous of becoming Associate Members and is to a large extent a body exercising administrative functions with respect to a particular profession all over the Kingdom. Obviously therefore the considerations which would induce the Authorities to vary the regulation and management of such a body as the Institution of Civil Engineers would not be applicable in the case of a purely Scientific Society.

Thirdly the reasons advanced for granting the Supplemental Charter to the Institution of Civil Engineers do not exist in the case of the Chemical Society. The Institution of Civil Engineers stated in the Petition for such Supplemental Charter whereas when their Charter was granted (in 1828) the number of Members of all classes was 156 that :—

> On the 2nd day of January 1896 the number of Members of all classes was 5969 the prescribed number of members of the Council is no longer sufficient to enable the institution to place on the Council an adequate number of representative men having regard to the total number of members and the scope of all branches of engineering science as now taught and practised throughout the realm and the number of members residing in or near the Metropolis now forms a comparatively small portion of the whole number and a large proportion cannot now be reasonably expected personally to attend General Meetings &c. &c.

In the case of the Chemical Society it cannot be alleged that the number of the Members of the Council is inadequate having regard to the total number of the Fellows the present number being 37 (including 15 vice-presidents who have been presidents) out of a total number of about 2100 Fellows. Under the existing Bye-Laws of the Institution of Civil Engineers the number of the Council "shall not be less than 23 nor more than 31" the total number of members of all classes of such Institution being at the present time about 6900.

It cannot be alleged that the Council of the Chemical Society has not contained from its foundation an adequate number of representative men. In fact the Memorial in favour of an alteration in the Bye-Laws states :—

> It is of course recognised that a custom has grown up of choosing a certain proportion of the officers and Council from among the Fellows who reside in the provinces.

It cannot be alleged that the number of Fellows of the Chemical Society residing in or near the Metropolis forms a comparatively small portion of the whole number or that a large proportion cannot now be reasonably expected personally to attend General Meetings. There has not in recent years been any material increase * in the proportion of the number of Fellows who do not reside in or near the Metropolis as compared with the whole body and there is the further fact that whereas the object of the Society above mentioned has remained unchanged since the date of its charter in 1849 means of transit and communication with the other parts of the Kingdom have since that date become greatly facilitated.

So far as is known there is no case in which a Supplemental Charter has been granted to an old scientific Society on the question of voting by proxy alone where that question has not involved other considerations than the mere question of attendance of the members thereof at General Meeting even if such body was unanimous in desiring a change in its constitution for this purpose.

Counsel is requested to advise the President and Council of the Chemical Society as to the chances of success of obtaining a Supplemental Charter.

1 If the Fellows were unanimous.
2 If there were a majority of the Fellows in favour of the proposed change and the minority took no active steps to oppose.

---

* Statistics of the Society.

	No. of Fellows.	Resident in London District.		Not resident in Great Britain and Ireland.		Country Members.	
			Per cent.		Per cent.		Per cent.
1869	526	241	45	27	5	258	49
1871	550	255	46	36	5	269	50
1881	1090	461	42	113	10	516	48
1891	1840	625	34	289	16	926	50
1897	2100	700	33	322	16	1078	51

3 If there should should be active opposition on the part of a minority of the Fellows.

4 If there were only a minority of the Fellows in favour of the change.

Also 5 How the majority for or against the change is to be ascertained. Must it be a majority of the whole of the Fellows or a majority of those voting at a General Meeting.

The following is the opinion of Counsel.

Copy of Opinion of Mr. Cozens-Hardy, Q.C.

Opinion.

1 2 3 and 4. The questions raised in this case are not really questions of law and I do not feel that any opinion I can give as to the chances of success of obtaining a Supplemental Charter can be of any value. But I may say that I think it highly improbable that the Government department before whom the application must come would be disposed to listen to the application unless it represented the practically unanimous view of the Fellows and that any active opposition by even a small minority would probably be fatal. The propriety of allowing votes by proxy or by voting papers transmitted through the post is obviously open to reasonable doubt. It is not easy to alter the constitution of a body of this nature except to give effect to the practically unanimous wish of the Corporators. I may add that the Supplemental Charter granted in 1895 to the Institution of Civil Engineers does not really furnish a precedent applicable to the present case. That Charter dealt with various important matters of which the allowance of proxy votes or voting papers was only one. I understand also that there was no difference of opinion on the part of the Fellows of that Institution.

5. In considering whether the Fellows really desire the change proposed I think regard must not be had only to those who are present in person at a meeting but in some other way the wishes of the whole body must be ascertained.

Herbert H. Cozens-Hardy.

7 *New Square, Lincoln's Inn,*
February 4, 1898.

It was announced that the following changes in the Officers and Council were proposed by the Council:—

As *Vice-Presidents*—Professor Liveing, F.R.S., and Professor J. M. Thomson, F.R.S., *vice* Mr. Ludwig Mond, F.R.S., and Professor Roberts-Austen, C.B., F.R.S.

As *Hon. Secretary*—Dr. W. P. Wynne, F.R.S., *vice* Professor J. M. Thomson, F.R.S.

As *Ordinary Members of Council*—Messrs. E. J. Bevan, H. J. Fenton, W. Gowland, and David Howard, *vice* Messrs. B. H. Brough, J. W. Rodger, T. K. Rose, and Professor Sydney Young.

Certificates were read for the first time in favour of Messrs. Albert Abbot, B.A., Church Street, Adlington, Chorley; Henry William Coupe-Annable, University College, Sheffield; William Thomas Gidden, 108, Vicarage Road, Langley, Birmingham; Alexander Guthrie, B.Sc., Bocking, Braintree, Essex; John Heaton, 81, Garmoyle Road, Liverpool; John Shearson Hyland, Ph.D., M.A., 11, Powis Square, Bayswater; William Jones, 29, High Street, Wavertree, Liverpool; Thomas Martin Lowry, B.Sc., 28, St. Lawrence Road, N. Kensington, W.; Albert Henry Mitchell, Martins Lane, Tiverton; Alfred James Parker, 21, East Hill, Dartford, Kent; Samuel Walker, M.A., B.Sc., 126, Gilmore Place, Edinburgh; Samuel Allinson Woodhead, B.Sc., Agricultural College, Uckfield.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected.

Messrs. Ernest Lionel Allhusen, B.Sc.; William Martin Bailey; Charles Edward Brittain, B.Sc.; Cecil Joslin Brooks; Benjamin S. Bull, M.A., B.Sc., Ph.D.; Charles Henry Burge; William Arthur Caldecott, B.A.; Matthew J. Cannon; Albert John Bullen Cooper; John Cooper, B.Sc.; William R. Cooper, M.A., B.Sc.; Frederick Cowling; Frederick Robertson Dodd; John R. Don, D.Sc., M.A.; Frederick W. Dootson, M.A.; Wilbraham T. A. Edwards; Frederick Gilderdale; William Setten Gilles; John Glaister, M.D.; Thomas Herbert Hills; David Homfray, B.Sc.; Atholl Francis McEwen; William Hobson Mills, B.A.; Gilbert Thomas Morgan; William Edward Moss; Herman Poole; Thomas Henry Pope; James Brown Reid; Frank Forster Renwick; William Colebrook Reynolds; William Richards; Harold Charles Sayer; Andrew Jamieson Walker, B.A.; Ernest Charles Weissmüller.

Messrs. H. T. Brown, F.R.S., F. D. Chattaway, and R. J. Friswell, were appointed to audit the Society's accounts.

Of the following papers those marked * were read :—

***14. "Observations on the influence of the silent discharge of electricity on atmospheric air." By W. A. Shenstone and W. T. Evans.**

When air is submitted to the action of the silent discharge it first contracts to a remarkable extent, and then re-expands rapidly until it very nearly occupies its original volume. The residue contains a trace of nitric peroxide. The following are some of the chief conclusions

arrived at from a study of the above phenomena. Oxygen, when diluted in nitrogen, as in the air, yields a very large proportion of ozone; 80—85 per cent. of the oxygen present may readily be ozonised in the presence of moisture, and if great care be taken as much as 98 per cent. of the oxygen may be converted into ozone.

If the ozonising of the oxygen be not pressed too far, no nitric peroxide will be formed, but at a certain stage, which probably coincides, or nearly coincides, with the point at which the amount of ozone is at its maximum, nitric peroxide is formed. In the presence of nitric peroxide, ozone is rapidly destroyed by the silent discharge, and its destruction is accompanied by a considerable destruction of nitric peroxide. The presence of water vapour promotes the formation of ozone, but retards that of nitric peroxide. It was found to be impossible to ozonise the oxygen of air in the presence of a trace of nitric peroxide.

DISCUSSION.

Dr. SCOTT asked if the diminution in the quantity of nitrogen peroxide present when all or almost all the ozone had again been decomposed might not be explained by its conversion by the moist air into nitric acid and so overlooked by the method of estimating the oxidised nitrogen which would not recognise it in this form.

Mr. SHENSTONE, in reply, said that he had not studied the effect of disruptive discharge, nor that of other diluents. In reply to Dr. ARMSTRONG, he said that the electrical conditions had been carefully regulated in the manner described in a previous communication to the Society, but all such details were now omitted, in order to economise space. In the present experiments, the difference of potential at the "spark gap" was about 13,300 volts. With regard to the question asked by Dr. Scott, of course one could not be sure that *no* nitric acid had been formed when the nitric peroxide disappeared in the presence of water, but this could hardly have occurred with the dried gas, and the behaviour of dried and damp gases seemed to correspond. Moreover, the gas was always remeasured after the ozone had been destroyed, and the amount of permanent contraction did not support the idea that the nitric peroxide had been to any considerable extent converted into nitric acid.

***15. "Some lecture experiments." By J. Tudor Cundall, B.Sc.**

Conservation of Mass.—Phosphorus in a weighed and closed flask is set on fire by passing a hot wire down the hollow stem of the deflagrating spoon containing it, thus raising the temperature of the spoon to the igniting point of the phosphorus.

Graham's Law of Diffusion.—A tube is filled so that it can be filled with hydrogen and other gases, and then connected to a filter pump by means of a closed up piece of the stem of a clay pipe, through the walls of which the gas can diffuse into the partial vacuum. The times that it takes for water to rise from one mark to another when the tube is filled with different gases are noted, and it is found that these are very nearly in the same ratio as the square roots of the densities of the gases.

DISCUSSION.

Professor ARMSTRONG observed that the apparatus used for ignition of the phosphorus was needlessly complicated. All that is necessary is a glass flask in which a piece of phosphorus is ignited by heating the flask, which is then closed with a rubber stopper. In this simple form, the experiment was well known in many elementary schools throughout the country.

***16. "Note on the preparation and properties of o-chlorbrombenzene." By J. J. Dobbie, M.A., D.Sc., and Fred Marsden, M.Sc., Ph.D.**

In this paper the authors describe the preparation and properties of o-chlorbrombenzene. It is a clear straw-coloured liquid with a strong aromatic odour. It boils constantly at 204° (i V) under a pressure of 765 mm., and does not solidify at $-10°$. Sp. gr. at $12{\cdot}5° = 1{\cdot}6555$. $\mu_D = 1{\cdot}583$.

***17. "The ultraviolet absorption spectra of some closed chain carbon compounds." By W. N. Hartley, F.R.S., and J. J. Dobbie, M.A., D.Sc.**

The authors give the results of the examination of the absorption spectra of a number of organic substances differing in constitution from those previously examined by Professor Hartley and his fellow-workers. The absorption spectra of substances containing closed chains wherein four or six carbon atoms are singly linked, or two pairs are doubly linked, and of substances containing oxygen or other polyvalent atoms as links in a closed chain, were studied. The examples selected were diketohexamethylene, pyrrol, thiophene, furfurane, furfurol, pyromucic acid, and furfuramide. Tables showing measurements of the extent and intensity of the absorption by each of these substances are given. The absorption of the ultraviolet rays by solutions of some of them, and notably of thiophene, is very intense, but in no case is there any selective absorption.

The conclusion arrived at is that however intense the absorption of the ultraviolet rays may be, bodies possessing the constitution of those examined show no absorption bands.

***18. "Note on the absorption bands in the spectrum of benzene." By W. N. Hartley, F.R.S., and J. J. Dobbie, M.A., D.Sc.**

In the earliest paper on the spectrum of benzene (Hartley and Huntington), it was described as showing six absorption bands, four of which are more persistent and stronger than the other two. Owing to the want of means to obtain a continuous spectrum, some difficulty was experienced in measuring with accuracy the weaker bands. By using a wide slit, lenses of long focus and a powerful spark, the rays are sufficiently continuous, but at a sacrifice of accurate measurement of the fiducial spark lines. One feature, however, was noticeable in spectra obtained in this way: the absorption bands were all degraded in the direction of the least refrangible rays. This was considered as suggestive of the bands consisting of groups of lines stronger and closer together on the more refrangible side, weaker and wider apart on the less refrangible. By using a very powerful spark the rays emitted by cadmium electrodes may be rendered sufficiently continuous to show these bands and at the same time render the lines sufficiently sharp to measure them by, and from such a photograph taken a year ago, the absorption bands have been again measured.

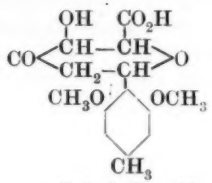
The results of the series of measurements taken from this photograph are compared with those obtained by Pauer by examining the vapour of benzene (*Wied. Ann.*, 1897, **61**, 362), and it is shown that his weak line λ 2670 is identical with the first absorption band, and his weak band λ 2390—2360 with the sixth absorption band observed in solutions of benzene in alcohol.

***19. "A chemical examination of the constituents of Indian and American podophyllum." By Wyndham R. Dunstan, F.R.S., and T. A. Henry.**

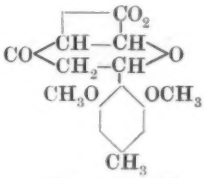
The authors find that the constituents of Indian podophyllum (*Podophyllum emodi*) and of American podophyllum (*Podophyllum peltatum*) are identical. The chief constituent is the *podophyllotoxin* of Podwyssozki and Kürsten which the authors have fully examined. It is a neutral crystalline substance (m. p. 117°), to which the authors assign the formula $C_{15}H_{14}O_6$. It is strongly lævorotatory, and acts as a powerful purgative and intestinal irritant. When heated with alkalis, it is converted by hydration into the salt of an unstable, gelatinous acid, *podophyllic acid*, $C_{15}H_{16}O_7$, of which a crystalline sodium salt was obtained, and also silver and copper salts, which were analysed. This acid very readily loses water, and furnishes the crystalline *picropodophyllin* of Podwyssozki and Kürsten, which is isomeric

with podophyllotoxin. It passes again into podophyllic acid when warmed with aqueous alkalis. It melts at 227°, and is optically inactive. Podophyllotoxin and picropodophyllin furnish identical decomposition products; when oxidised with nitric acid, *oxalic acid* is the principal product; when fused with alkalis, *orcinol* and *acetic acid* are produced. Both substances contain two methoxyl groups and no hydroxyl. It is concluded that picropodophyllin is the lactone of podophyllic acid, which is probably the hydroxy-carboxylic acid of *dimethoxymethyl-phenylhydro-γ-pyrone.*

The following formulæ are assigned to these compounds:



Podophyllic acid.



Picropodophyllin.

The nature of the isomerism of podophyllotoxin and picropodophyllin remains to be determined. The latter substance is therapeutically inert.

The yellow colouring matter of podophyllum, called by Podwyssozki podophylloquercetin, is proved by the authors to be identical with *quercetin*, the valuable yellow colouring matter of quercitron bark.

An uncrystallisable resin, *podophylloresin*, was also isolated and found to exert a purgative action.

Estimations have been made of the amount of "podophyllin" (a mixture of resins with podophyllotoxin which is used in medicine) contained in the two plants. Indian podophyllum contains from 9 to 12 per cent., and American from 4 to 5 per cent. The two resins have been proved to be equally valuable therapeutic agents. The amount of crystalline podophyllotoxin in the Indian plant varies from 2 to 5 per cent., whilst representative samples of the American rhizome were found to contain rather less than 1 per cent.

Indian podophyllum is likely to be valuable both as a drug and as a dye-stuff.

Discussion.

Mr. E. J. Millard asked if Professor Dunstan had noticed and could account for the smaller solubility of the resin from *P. emodi*. This was specially marked in the presence of a small quantity of an alkali when it assumed a gelatinous consistency. Since attention had been drawn to this resin by Professor Dunstan, manufacturers had prepared it in considerable quantities and it was known commercially as the less soluble variety.

Professor DUNSTAN said, in reply, that any difference that may be observed in the solubility and other properties of podophyllin resin prepared from Indian podophyllum and that prepared from American podophyllum was probably accounted for by the different proportions in which the constituents were mixed in the resins prepared from the two sources and not by any difference in the constituents themselves.

***20. "The volatile constituents of the wood of Goupia tomentosa." By Wyndham R. Dunstan, F.R.S., and T. A. Henry.**

Goupia tomentosa is a large tree growing in British Guiana, where it is known as 'kabucalli.' The wood is hard, and is used in the colony for boat-building. When freshly cut it emits a smell resembling that of valerian. By distilling the wood with water, a mixture of acids of the acetic series was obtained, from which the authors have isolated and identified *formic acid*, *isovaleric acid*, *normal caproic acid* and *lauric acid*. A small quantity of *succinic acid* was also obtained.

***21. "On oxycannabin from Indian hemp." By Wyndham R. Dunstan, F.R.S., and T. A. Henry.**

Oxycannabin is the name given by Bolas and Francis to a crystalline substance they obtained by acting on the pharmacopœial extract of Indian hemp with concentrated nitric acid (*Trans.*, 1869, **22**, 417; *Chem. News*, 1871, **24**, 77). They obtained it in the form of yellow needles melting at 176°, and represented its composition by the formula $C_{20}H_{20}N_2O_7$. In the course of the examination of the constituents of Indian hemp, the authors have prepared the substance in this way, and have also obtained it by the action of fuming nitric acid on the "cannabinol" isolated by Messrs. Wood, Spivey and Easterfield (*Trans.*, 1896, **69**, 544) from the "charas" or resin of Indian hemp.

When quite pure, oxycannabin crystallises in colourless needles melting at 182°; it is insoluble in water, but soluble in hot alcohol, crystallising out on cooling. It sublimes when gently heated, and may be easily purified in this way. On combustion, the substance gives numbers agreeing with those required by the formula $C_{10}H_{10}NO_4$.

It does not dissolve in aqueous alkalis unless warmed with them in a closed tube. By acidifying the resulting solution, an acid is precipitated which is at present under investigation. "Oxycannabin" would therefore appear to be a lactone.

On reduction with hydriodic acid, or with tin and hydrochloric acid, oxycannabin furnishes a volatile amine. The hydrochloride of this base, though itself unstable, gives a well-crystallised platinichloride.

When heated with zinc dust, oxycannabin gives off a large amount of an inflammable gas (probably methane), and a quantity of an aromatic hydrocarbon is produced, which forms a well-crystallised compound with picric acid.

By the action of nitric acid on cannabinol, *normal butyric acid* was also produced, together with *oxalic acid*.

As the substance is thus proved to be a nitro-compound, the name "oxycannabin" is inappropriate, but it would be premature to propose a new name until more is known about the constitution of the compound.

In the course of purifying cannabinol through the acetyl derivative mentioned by Messrs. Wood, Spivey and Easterfield, the acetyl derivative was obtained in colourless crystals melting at 75°, which corresponded in composition to the formula $C_{18}H_{23}AcO$.

Discussion.

The President remarked that a similar investigation of the products of "oxycannabin" had been carried on for some time in the University Laboratory at Cambridge by Messrs. Spivey and Easterfield, and that they had isolated substantially the same products.

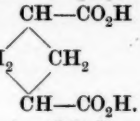
22. "On the condensation of formaldehyde with ethylic malonate, and on cis- and trans-tetramethylenedicarboxylic acids (1 : 3)." By E. W. Haworth and W. H. Perkin, jun.

In a paper published some time since (*Ber.*, 1886, **19**, 1053), it was shown that when formaldehyde condenses with ethylic malonate in the presence of acetic anhydride, the principal product of the reaction is ethylic propanetetracarboxylate, $(CO_2Et)_2CH\cdot CH_2\cdot CH(CO_2Et)_2$, but that at the same time a substance boiling at 208—212° is produced in small quantities, which, from the results of the analysis, was thought at the time to be ethylic methylenemalonate, $CH_2{:}C(CO_2Et)_2$.

In further investigating this reaction with large quantities of material, these results have been confirmed. The condensation product contains the following substances.

(1). *Ethylic methylenemalonate*, $CH_2{:}C(CO_2Et)_2$, distils at 208° as a colourless oil which, on standing, rapidly polymerises into a hard, wax-like substance, which is sometimes transparent and sometimes opaque. The polymeride, which is probably identical with the substance obtained by Zelinsky (*Ber.*, 1889, **22**, 3294) by the action of methylene iodide on ethylic malonate, on distillation, yields small quantities of ethylic methylenemalonate, and considerable quantities of high-boiling oils which are at present under investigation.

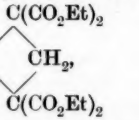
When hydrolysed with alcoholic potash, the polymeride yields



cis-tetramethylenedicarboxylic acid (1 : 3) $CH_2(CH_2 \cdot CH(CO_2H))_2$.

(2). An oil boiling at 234—236° (80 mm.). Ethylic propanetetracarboxylate, $(CO_2Et)_2CH \cdot CH_2 \cdot CH(CO_2Et)_2$.

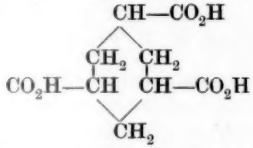
(3). An oil boiling at 250—300° (40 mm.), which evidently contains



ethylic tetramethylenetetracarboxylate, $CH_2(CH_2 \cdot C(CO_2Et)_2)_2$, since, on hydrolysis, an acid is obtained which, after elimination of carbon dioxide and etherification, yields *ethylic cis-tetramethylenedicarboxylate* (1 : 3) (b. p. 172° at 50 mm.). This ethereal salt, on hydrolysis, yields pure cis-tetramethylenedicarboxylic acid melting at 131°.

(4). When the fraction 250—300° (40 mm.) is treated as above, it yields besides ethylic cis-tetramethylenedicarboxylate, an ethereal salt boiling constantly at 202° (30 mm.), and from this, on hydrolysis, a crystalline acid is obtained melting at 114°.

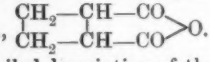
This acid, which on analysis gives numbers agreeing well with the formula $C_9H_{12}O_6,H_2O$, is probably *hexahydrotrimesic acid*,



and in order to determine whether this view is correct, the acids formed by reducing trimesic acid are being investigated. The authors have already succeeded in preparing a crystalline tetrahydrotrimesic acid, $C_6H_7(CO_2H)_3$, which melts at about 185°, and is characterised by being very sparingly soluble in ether, but excessively soluble in water.

During the course of this research, Markownikoff's work on the action of dry sodium ethylate on ethylic α-chloropropionate has been carefully repeated (*Journ. Russ. Chem. Soc.*, 1890, **22**, 285; *Ann.*, 1881, **208**, 333). It is found that both the cis- and trans-modifications of tetramethylenedicarboxylic acid (1 : 3) are formed in this way, and not only the trans-modification as Markownikoff states. The trans-acid (m. p. 171°), on treatment with acetylchloride, yields the anhydride of the cis-acid (m. p. 50—51°), and this, on treatment with water, is readily converted into the cis-acid (m. p. 131°).

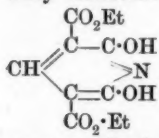
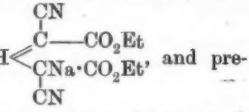
It is remarkable that Markownikoff, who first observed this be-

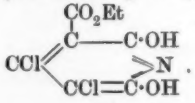
haviour, should have assumed that the trans-tetramethylenedicarboxylic acid, during this series of reactions, undergoes molecular change, and that the anhydride melting at 50—51° is the anhydride of tetramethylenedicarboxylic acid (1 : 2), *i.e.*,  .

It will be shown in the detailed description of the experiments that Markownikoff's view, which has caused a good deal of confusion in the chemistry of the tetramethylenecarboxylic acids, is certainly incorrect.

The authors are also engaged in investigating the action of methylene iodide on the disodium derivative of ethylic propanetetracarboxylate, and hope to be able soon to communicate the results of their experiments to the Society.

23. "Formation of ethylic dihydroxydinicotinate from ethylic cyanacetate." By S. Ruhemann, Ph.D., M.A., and K. C. Browning, B.A.

The authors give an account of their examination of the mother liquor from the preparation of ethylic sodio-dicarboxyglutaconate. They succeeded in isolating from it ethylic dihydroxydinicotinate,  , and attribute the formation of this compound to the presence of ethylic cyanacetate in the ethylic malonate. In order to verify this explanation, they studied the action of chloroform on ethylic cyanacetate in the presence of sodium alcoholate. They thus obtained ethylic sodio-dicyanglutaconate,  , and prepared from it other metallic compounds and the ethereal salt itself (compare Errera, *Gaz. chim. Ital.*, 1897, **27**, 393). On boiling the ethereal salt with dilute hydrochloric acid, ethylic dihydroxydinicotinate (m. p. 202°) is formed. Chlorine transforms the pyridine-derivative into ethylic dichlordihydroxynicotinate, to which, from its behaviour towards phenylhydrazine, they assign the formula



At the next meeting, on Thursday, March 3rd, the following papers will be communicated by the authors.

"Note on the preparation of dry hydrogen cyanide and carbon monoxide." By John Wade, B.Sc., and Laurence C. Panting, M.B., B.Ch.

"Production of nitro- and amido-oxylutidines." By Professor J. N. Collie, Ph.D., F.R.S., and T. Tickle.

"Production of some nitro- and amido-oxylutidines. Part II." By Professor J. N. Collie, Ph.D., F.R.S., and Miss L. Hall.

"On benzene hexabromide." By F. E. Matthews, Ph.D.

"Note on manganic salts." By C. E. Rice, B.A.

"Some chemical properties of concentrated solutions of certain salts." Part I. Potassium carbonate." By W. C. Reynolds.

RICHARD CLAY AND SONS, LIMITED, LONDON AND

Issued 10/3/1898.

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 190. Session 1897–8.

March 3rd, 1898. Professor Dewar, F.R.S., President, in the Chair.

Mr. Cecil J. Brooks was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. Joseph Brierley B.Sc., Ashton Road, Failsworth, Manchester; Arthur William Cowburn, Fernroyd, Bowdon, Cheshire; Charles Benjamin Dudley, Ph.D., Attoona, Penn., U.S.A.; Arthur Leonard Harry Garside, c/o C. Lawes and Co., Barking Creek; Lawrence Hislop, Gasworks, Uddingston; F. Hurter, Ph.D., Holly Lodge, Cressington Park, Liverpool; Samuel Morton Jessop, 12 Hanson Terrace, Wakefield; George Henry Masson, M.D., M.S., 22 Lauriston Place, Edinburg; Walter Charles Cross Paters, 14 Trinity Square, S.E.; Francis Pitt Smith, B.Ph., 77 Woodland Avenue, New Rochelle, N.Y., U.S.A.; Thomas de Smith, B.A. Eastbourne College, Eastbourne; William Thomas Newton Spivey, M.A., 5 Trumpington Street, Cambridge; John Alexander Williamson, 81 Cheverton Road, Upper Holloway, N; Thomas Barlow Wood, M.A., Caius College, Cambridge.

Of the following papers those marked * were read :—

***24. "Preparation of anhydrous hydrogen cyanide and carbon monoxide." By John Wade, B.Sc., and Laurence C. Panting, M.B.**

On allowing a cold mixture of equal volumes of sulphuric acid and water to drop on to 98 per cent. "lump" potassium cyanide, hydrogen cyanide, accompanied by traces of water only, is evolved in almost theoretical amount, and with the aid of suitable condensing apparatus is readily collected in quantity. With concentrated sulphuric acid, on

the other hand, but still at the ordinary temperature, nearly pure carbon monoxide is evolved, also in quantity approaching the theoretical; provided certain precautions are taken, it is free from dioxide, and is accompanied only by small quantities of hydrogen cyanide.

In discussing the mechanism of the formation of the monoxide, experiments are described showing that part of the water required for the hydrolysis is derived either from the sulphuric acid itself or from the potassium hydrogen sulphate formed in the course of the action, and that consequently the sulphuric acid acts at the same instant both as a hydrolyst and as a dehydrating agent.

***25. "Production of some nitro- and amido-oxylutidines." By J. N. Collie, Ph.D., F.R.S., and Thomas Tickle.**

In a former paper (*Trans.*, 1897, **71**, 838) one of the authors drew attention to the fact that various nitro- and amido-derivatives of pyridine could be obtained by the ordinary process of nitration and reduction of certain oxypyridine compounds. These substances correspond in the pyridine series to nitro- and amido-phenols in the benzene series, and as some of the reactions (especially those with various oxidising agents) of the amido-oxypyridines resemble those of alkaloids, the investigation has been continued.

Pseudolutidostyril ($\alpha\gamma$-dimethyl-α'-oxypyridine) gave on nitration a *nitropseudolutidostyril*, $C_5HNMe_2(OH)NO_2$. It crystallises in light yellow needles that melt with much decomposition at about 250°. The hydroxyl and nitro-groups are in the ortho-position to one another, but the substance is not volatile with steam. With alkalis, it forms brilliant, yellow compounds.

When the nitro-compound is reduced with tin and hydrochloric acid, an amidopseudolutidostyril is produced. The hydrochloride of this base, $C_5HNMe_2(OH)NH_2HCl$, crystallises in needles which decompose without melting at 235—240°. By the action of sodium bicarbonate, the free base can be obtained in the form of a bulky mass of fine needles, m. p. 205° (corr.). The base is very soluble in hot water, but much less so in cold. It oxidises readily, and an aqueous solution on boiling turns brown. This solution reduces silver nitrate at once. With ferric chloride, it gives first a red and then a bright green colour, and when dissolved in strong sulphuric acid, if a drop of fuming nitric acid be added, a brilliant purple colour is momentarily produced. It forms a platinichloride and an acetyl derivative, m. p. 255° (corr.).

By nitrating ethylic pseudolutidostyrilcarboxylate (m. p. 137—138°) a nitro-derivative was formed, $C_5N{\cdot}Me_2(OH)(CO_2Et)NO_2$. This substance, m. p. 215° (corr.), crystallises in yellow needles. On hydrolysis,

it yielded the corresponding acid, m. p. 260° (corr.), which when pure is almost colourless, but forms bright yellow salts. The acid on heating loses carbon dioxide and the same nitro-pseudolutidostyril (m. p. about 250°) was obtained.

Amido-pseudolutidostyrilcarboxylic acid was prepared from the corresponding nitro-acid by reduction. Its hydrochloride crystallises from water in needles with 2 molecules of water. The amido-acid melts at 275° (corr.), and contains 1 molecule of water of crystallisation; above its melting point it decomposes, yielding amido-pseudolutidostyril (m. p. 205° corr.). Its salts reduce silver nitrate solution, and with ferric chloride give a green coloration.

***26. "Production of some nitro- and amido-oxylutidines. Part II." By Miss L. Hall and J. Norman Collie, Ph.D., F.R.S.**

Lutidone, *aa'*-dimethyl-γ-oxypyridine, when warmed with nitric acid, does not yield a nitro-derivative (*Trans.*, 1897, **71**, 838), but a nitrate of lutidone. If, however, a mixture of strong nitric and sulphuric acids are employed, the nitro-compound is formed, $C_7H_9NO + HNO_3 = C_7H_8NO\cdot NO_2 + H_2O$. This nitrolutidone is a pale yellow, crystalline compound, possessing a strong acid reaction, and dissolving in alkalis with an intense yellow colour; it is not volatile in steam. When reduced with tin and hydrochloric acid, it yields an amido-lutidone, $C_7H_8NO\cdot NO_2 + 3H_2 = C_7H_8NONH_2 + 2H_2O$. This amidolutidone, unlike amidodioxypicoline and amidopseudolutidostyril, does not give characteristic colours with oxidising agents, but acts as a strong reducing agent. It forms both a monohydrochloride and a dihydrochloride. The platinichloride is unstable; it undergoes reduction when dissolved in water and warmed, but if its hydrochloric acid solution is boiled, a very insoluble platinichloride separates, which seems to be the salt of propine diamine, $\begin{matrix} Me\cdot C\cdot NH_2 \\ \| \\ HC\cdot NH_2 \end{matrix}$ $2HCl\cdot PtCl_4$, the decomposition having been brought about by hydrolysis, $C_7H_{10}N_2O + 3H_2O = C_3H_8N_2 + 2C_2H_4O_2$. This breaking down of the pyridine ring is of considerable interest, and, in a substance like lutidone, is hardly to be expected, since the nitrogen atom is bound to two carbon atoms, neither of which are united to oxygen, and, moreover, lutidone is not the anhydride of an amido-acid.

Discussion.

Mr. Ling pointed out that certain anilides give, when treated with oxidising agents in acid solution, colour reactions similar to those obtained with alkaloids (Tafel, *Ber.*, 1892, **25**, 412; Schär, *Archiv Pharm.*, 1894, **232**, 249).

Prof. COLLIE, in reply to suggestions of Dr. WYNNE, pointed out that it was impossible in the case of lutidone to obtain more than one mono-nitro-derivative. In nitrating pseudolutidostyril, the position of the entering nitro-group had been determined with certainty by the fact that pseudolutidostyrilcarboxylic acid, after nitration and subsequent heating, yielded the same nitro-compound as had been obtained from pseudolutidostyril itself.

***27. "On benzene hexabromide." By F. E. Matthews, Ph.D.**

In this paper, the author describes his failure to isolate the second modification of benzene-hexabromide, obtained, in minute quantity, by Orndorf and Howells (*Amer. Chem. Journ.*, 1896, **18**, 312—319) even from considerable quantities of the crude hexabromide; also the failure to prepare either the hexachloride or hexabromide of bromobenzene; in the former case owing to the displacement of chlorine by bromine, and in the latter to the substitution of bromine taking place more readily than direct addition.

The action of alcoholic soda upon benzene hexabromide is also described, the product of the action being a mixture of paradibromo- and tribromobenzene (1 : 2 : 4), possibly mixed with a small amount of one of the other dibromobenzenes. Benzene obtained from the hexabromide by nascent hydrogen in acid alcoholic solution yields both modifications of the hexachloride on treatment with chlorine.

DISCUSSION.

Professor TILDEN was glad that Dr. Matthews had resumed work on these interesting compounds. He had repeated some of Dr. Matthews' experiments, and had satisfied himself that the hexachloride was obtainable very readily and in very large proportion. It was somewhat remarkable that the corresponding bromide should be formed so much less readily.

Dr. MATTHEWS stated that he had always worked with material spontaneously precipitated from the mixture of benzene, bromine, and water, and not with the substance left after evaporating the mixture to dryness, as was the case with Orndorf and Howells.

***28. "Note on the action of bromine on benzene." By J. Norman Collie, Ph.D., F.R.S., and Colin C. Frye.**

The authors have repeated the work of Ador and Rilliet (*Ber.*, 1875, **8**, 1286) who stated that when bromine was allowed to act on excess of benzene in sunlight, dibromo-addition products were produced, which, after treatment with zinc ethyl and subsequent oxidation with chromic

acid, yielded metabromo- and metaphthalic acids, together with benzoic acid, parabromobenzoic, and terephthalic acid, but they were unable to obtain any ortho-compounds. The authors have succeeded in proving the presence of ortho-compounds, and at the same time have confirmed the observations of Ador and Rilliet, having isolated para-bromobenzoic acid and metaphthalic acid.

Discussion.

Dr. Matthews said that he had made several attempts to isolate di- and tetra-chlorine and bromine addition-compounds of benzene, both by the action of the halogens upon excess of benzene and also by decomposition of the hexabromide and hexachlorides of benzene, but always without finding a trace of any di- or tetra-halogen addition-derivative.

***29. "Note on manganic salts." By C. E. Rice, B.A.**

The author shows that the decomposition of manganic chloride in solution into manganous chloride and chlorine is reversible, the velocity of the reverse change being very small. He also describes the production and analysis of two double manganic chlorides, $2KCl \cdot MnCl_3, H_2O$ and $2NH_4Cl \cdot MnCl_3, H_2O$, but obtains no evidence of the existence of any compound of the formula $MnCl_4$.

Discussion.

Professor Clowes asked which of the manganese hydroxides was precipitated by the action of water upon the crystalline hydrated double chloride; it would be interesting to know whether a hydroxide corresponding to the formula $MnCl_3$ could exist.

Professor Tilden remarked that the manganese tetrachloride seemed to be now finally disposed of, and in representing the production of chlorine by the usual process we should have to write a new equation.

Mr. Rice, in reply, said that he had not considered it necessary to investigate the point, since Pickering had shown that when the solution obtained by dissolving any of the higher oxides of manganese (Mn_2O_3, Mn_3O_4, MnO_2) in hydrochloric acid is diluted, the precipitate consists of a mixture of these hydrated oxides in varying proportions.

***30. "Some chemical properties of concentrated solutions of certain salts. Part I. Potassium carbonate." By W. Colebrook Reynolds.**

When the salts of certain other metals are added to a concentrated solution of potassium carbonate, double salts are formed which are sometimes, as in the cases of iron, copper, nickel, and cobalt, soluble in the

solution, instead of the normal or basic carbonates which are formed when a dilute solution is employed.

These double salts and their solutions are decomposed by pure water. To obtain them, the chloride, nitrate, or preferably the acetate, is added to a concentrated solution of potassium carbonate (sp. gr. 1·55), and the liquid left to crystallise. The author has isolated the following double salts in well defined crystalline form:— $CuK_2(CO_3)_2$, $CuK_2(CO_3)_2,H_2O$, $CuK_2(CO_3)_2,4H_2O$, $MnK_2(CO_3)_2,4H_2O$, $FeK_2(CO_3)_2,4H_2O$, $CaK_2(CO_3)_2$, $Bi_2OK_4(CO_3)_4,H_2O$, $CoK_2(CO_3)_2,4H_2O$, $NiK_2(CO_3)_2,4H_2O$, $MgK_2(CO_3)_2,4H_2O$, $AgKCO_3$. The last four salts have been previously obtained by other chemists.

Discussion.

Professor Tilden said that Mr. Reynolds had been led to the study of these compounds in the course of enquiring into the production of the recently discovered percarbonates. In dilute solution, potassium carbonate appeared to be resolvable into the ions 2K and CO_3, while in a saturated solution it behaved as though made up of K and KCO_3. Mr. Reynolds had omitted to point out that in the formulæ of all his new double carbonates, the heavy metal seemed to be associated with a proportion of KCO_3 corresponding to its valency. Perhaps this was only a coincidence, but it seemed to deserve notice.

Mr. A. G. Bloxam remarked that if carbonic acid was regarded as a hydroxy-acid the formation of a deep blue coloured solution by mixing a concentrated solution of potassium carbonate with a solution of copper sulphate became of interest as bringing carbonic acid into line with other hydroxy-acids, all, or nearly all, of which were known to give deep blue coloured solutions with copper sulphate and alkali sufficient to satisfy both the acidic and phenolic or alcoholic hydroxyl groups. Such solutions, however, were more stable than the potassium copper carbonate solution of Mr. Reynolds, and this might be due to a comparatively unstable condition of potassium carbonate in solution; if a strong solution of this salt was partly decomposed on dilution, potassium hydroxide and bicarbonate being formed, a corresponding decomposition of the copper compound would be expected. He would be glad to learn from Mr. Reynolds whether addition of potassium hydroxide hindered the precipitation of copper carbonate on dilution.

Mr. W. P. Bloxam asked whether the formation of these salts was attended with the evolution of carbon dioxide. Had the author taken into account the hydrolysis of potassium carbonate which took place in aqueous solution? According to a paper published by Senderens, the action of a non-metallic element (sulphur) upon solution of potassium carbonate could be explained by regarding the salt as hydrolysed thus, $H_2O + K_2CO_3 = KHCO_3 + KOH$; and experiments made by the

speaker showed that even a concentrated solution of the salt must be regarded as possessing this constitution. The presence of more oxygen in the double carbonate of bismuth than that present in the acid groups would be explained by the action of the hydroxide groups present in the carbonate solution. The same reaction would also explain the difficulty of obtaining manganous and ferrous double carbonates.

Mr. Reynolds, in reply, stated that it was possible to represent the formation of these compounds as taking place in accordance with such an equation as, for instance, $MnCl_2 + 2K \cdot KCO_3 = Mn(KCO_3)_2 + 2KCl$, and this view was strengthened by the fact that some of the salts, as, for instance, copper acetate, dissolved immediately without forming a precipitate which subsequently redissolved.

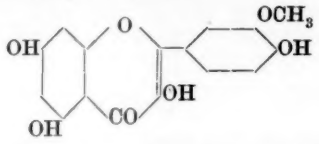
In the case of the double succinates, however, where exactly the same phenomena occurred, the composition of the copper compound was $CuK_4(C_4H_4O_4)_3,2H_2O$, and this could not be represented by a similar equation. He had, therefore, not introduced such views into the present paper, as they did not appear to be generally applicable.

The author did not think that any of the phenomena supported the view that the solution contained potassium hydroxide and potassium bicarbonate, as no effervescence occurred, except in the case of normal bismuth salts, when basic salts were formed.

31. "The colouring matters of the Indian dyestuff Delphinium zalil." By A. G. Perkin and J. A. Pilgrim.

"Asbarg" consists of the dried flowers and flowering stems of the *Delphinium zalil*, found in great quantity in Afghanistan, and which is much used in India for the production of a yellow colour on alum mordanted fabrics. The flowering stems are nearly devoid of dyeing property. For the supply of material we are indebted to the authorities of the Imperial Institute. Three colouring matters exist in this plant in the form of glucosides. The sparingly soluble colouring matter, $C_{16}H_{12}O_7$, forms glistening yellow needles, soluble in alkalis with a yellow colour. Fused with alkali it yielded phloroglucinol and protocatechuic acid, and by means of hydriodic acid it yielded quercetin with the evolution of 1 mol. of methylic iodide. By methylation it was converted into quercetintetramethyl ether, and by acetylation into a tetracetyl derivative of the formula $C_{16}H_8O_7(C_2H_3O)_4$, colourless needles, m. p. 195—196°. It was evidently *isorhamnetin*, a quercetinmonomethyl ether, recently isolated from the yellow wallflower, *Cheiranthus Cheiri* (Trans., 1896, **69**, 1650). As by oxidation in

alkaline solution this yields vanillic acid, it has most probably the constitution represented by this formula.



With alumina as mordant it dyes a purer yellow than quercetin. The chief constituent of the more soluble portion was recognised to be identical with *quercetin*, the colouring matter of quercitron bark. The residual colouring matter, present only in small quantity, was not obtained in a pure condition. It resembled quercetin in percentage composition, and in its decomposition products, but differed from it in not reacting with alcoholic potassium acetate, and the melting point of its acetyl derivative. "Asbarg" resembles quercitron bark in dyeing property, but has only 35 per cent. the tinctorial power of this dyestuff. It contains, when freed from the flowering stalks, 3·47 per cent. of colouring matter (not as glucoside).

32. "Some metallic salts of natural yellow colouring matters." By A. G. Perkin and P. J. Wood.

That certain colouring matters decompose alkaline carbonates with the formation of acid salts has been previously demonstrated. Thus of morin, Hlasiwetz and Pfaundler describe salts of this description, and of quercetin (*Jahresbericht*, 1864, 560). Further, from gentisin, Hlasiwetz and Habermann (A. 1875, **175**, 73) obtained analogous compounds. Among other instances is bixin, the colouring matter of Annatto, which Etti describes (*Ber.*, 1878, **11**, 864) as giving a sodium and a potassium salt, and rottlerin, from which one of us obtained similar compounds (Trans., 1895, **67**, 230).

Owing probably to the formation of acid salts these alcoholic alkaline solutions are not readily neutralised completely by acetic acid, and as it appeared that some of the formulæ of the above compounds must be incorrect, this reaction was studied. It was found that in alcoholic solution, quercetin, morin, fisetin, and myricetin decompose potassium and sodium acetates with the formation of sparingly soluble salts. *Potassium quercetin*, $C_{15}H_9O_7K$ (Found K = 11·46. Theory requires K = 11·47), forms minute orange-yellow prismatic needles, insoluble in cold water and but slowly decomposed by boiling dilute acetic acid. *Sodium quercetin*, $C_{15}H_9O_7Na$, closely resembles the above salt. *Potassium morin*, $C_{15}H_9O_7 \cdot K$ (Found K = 11·97. Theory requires K = 11·47), separates as glistening, orange-coloured needles, and is closely resem-

bled by *sodium morin*, $C_{15}H_9O_7Na$ (Found Na = 6·89. Theory 7·09). Morin reacts with magnesium and ammonium acetates, though from quercetin salts have not been obtained in this way. *Ammonium morin* and *magnesium morin* separate in the form of long needles in a similar way (Found Mg = 3·52. Theory requires Mg = 3·83 per cent.).

Fisetin and myricetin apparently yield analogous derivatives, and on the other hand luteolin, apigenin, chrysin, and gentisin do not appear to react with alkaline acetates. With the exception of bixin and rottlerin, as yet but little examined, the above colouring matters are known to contain no carboxyl group, and it is thus of interest to study this reaction in which only one of the numerous hydroxyls present takes part. It appears probable that some analogy exists between these salts and the acid compounds of the colouring matters described by one of us (Trans., 1896, **69**, 1439).

33. "The interaction of magnesium and solution of copper sulphate." By Edward Divers, M.D., F.R.S.

Neither Clowes and Caven nor Tilden, in their communications made to the Society in November last, seem to the writer to have recognised the significance of the results of the interaction of magnesium metal and a solution of copper sulphate. Remarkable as these results are, it is to be remembered that a closely analogous case had long been known, even when Commaille in 1866 observed them, namely, that of zinc immersed in a solution of an alum. Here, also, there is free evolution of hydrogen and precipitation of basic sulphate, and, when chromium alum replaces the aluminium salt, there is also reduction of some of the chromic sulphate to chromous sulphate. The only part of the change which finds no parallel in the action of zinc upon chrome alum is that of the deposition of a little copper, but this deposition is quite in accordance with the general behaviour of copper salts.

The formation of basic salt and hydrogen is a change independent of that of reduction, as is clearly shown by the same formation taking place, without that of reduction, when aluminium sulphate or common alum is concerned. Now, since the alum solution is dialysable into sulphuric acid and basic aluminium or chromium sulphate (besides potassium sulphate), and is also strongly acid in reaction, it will be admitted by all that the action in the case of an alum is really that of dilute sulphuric acid upon the zinc. The gradual precipitation of the previously soluble basic salt as the zinc dissolves in the solution is just what happens when zinc sulphate is dissolved in a dialysed solution of aluminium, or chromium hydroxide, or basic sulphate. These two points being admitted, it will be very difficult to doubt that

similar changes occur between copper sulphate and magnesium, or, in a less degree, zinc; for the solution is here also very acid in reaction and needs only a little boiling to make it deposit basic sulphate; besides, too, it will unquestionably show largely that hydrolysing action upon cane-sugar which Long (*J. Amer. Chem. Soc.*, 1896, **18**, 120) has recently shown so many metallic salts possess, and this property is evidence that, like aluminium sulphate, it is partly hydrolysed into sulphuric acid and soluble basic sulphate, which will be precipitated as magnesium goes into the solution. Caven and Clowes have pointed out the inadequacy of the action of the magnesium-copper couple to account for the large evolution of hydrogen. Their unsupported suggestion that the hydrogen is formed by the combined action of copper sulphate (as such) and magnesium upon water, has likewise little claim to consideration in presence of the fact that (hydrolysed) aluminium sulphate acts in the same way as copper sulphate.

Coming now to the production of cuprous oxide, a separate reaction, or set of reactions, there would be nothing in this unlike that of the reduction of ferric or chromic sulphate by zinc or magnesium, could cuprous salt only be found in solution. When, in place of the sulphate, cupric chloride is used, then, as every one knows, there is just this looked-for reduction to cuprous salt. But the peculiarity of copper is that oxylic cuprous salts are apparently unable to exist. It is, however, not so improbable that in dilute solution and in presence of much cupric sulphate a little cuprous sulphate may exist for a very short time. According, indeed, to Rose, from roasted copper sulphide water extracts, along with cupric sulphate, a little cuprous sulphate, which then gradually decomposes into metal and cupric salt, just as a mercurous salt in water will change into metal and mercuric salt (*Annalen*, 1841, **39**, 109). However that may be, and the observation admits of another interpretation, it does seem to the writer that the precipitation of cuprous oxide during the action of magnesium upon cuprous sulphate is a fact highly favourable to the view that cuprous sulphate is actually formed, part of it then quickly decomposing into cupric sulphate and metallic copper, and the rest of it being decomposed by the basic cupric salt into normal cupric sulphate and cuprous oxide. With certainty he can state that, when finely divided copper is acted upon by nitrogen peroxide, nitric oxide and a copper nitrate are formed, and no nitrite, and that this copper nitrate, when touched with water, decomposes into cupric nitrate and bright metallic copper, thus proving, apparently, that in absence of water cuprous nitrate can exist, and, therefore, by analogy, other oxylic cuprous salts.

There remains only to notice Tilden's suggestion that some of the hydrogen reduces cupric to cuprous oxide. Hydrogen is known not to have such an action, and therefore the usual assumption of there

being a more active 'nascent' hydrogen has to be made, but also without the least foundation in experience. In the present case, it may be pointed out, firstly, that in the reduction of chromic sulphate to chromous sulphate by zinc, hydrogen continues to be evolved, although very great excess of chromic salt is always in contact with the zinc; and, secondly, that in the reduction of ferric salts by zinc it has been established that this takes place much more rapidly when clean zinc dust is put into the ferric solution in the absence of excess of acid, than when, as is usual, an excess of acid is added to generate hydrogen. It may, therefore, with great probability be assumed that the reactions are $2CuSO_4 + Mg = Cu_2SO_4 + MgSO_4$ and $Fe_2(SO_4)_3 + Zn = 2FeSO_4 + ZnSO_4$, hydrogen having nothing to do in the matter.

ADDITIONS TO THE LIBRARY.

I. *By Purchase.*

Groth P. Tabellarische übersicht der Mineralien nach ihrn krystallographisch-chemischen beziehungen. Vierte auflage. Pp. viii + 184. Braunschweig 1898.

Wollny, Ewald. Die zersetzung der organischen stoffe und die humusbildungen mit rücksicht auf die bodencultur. Pp. x + 479. Heidelberg 1897.

II. *Donations.*

Bailey, G. H. The Tutorial Chemistry. Part II. Metals. Pp vi + 295. London 1898. From the Author.

Roscoe, H. E., und Classen, A. Lehrbuch der anorganischen Chemie Zweiter band. Dritte gänzlich umgearbeitete auflage des infrüheren auflagen von Roscoe und Schorlemmer bearbeiteten werkes. Braunschweig 1897. From Sir H. E. Roscoe.

Pamphlets.

Louis, D. A. The Iron Industry of Hungary. (Reprinted from the *Journal of the Iron and Steel Inst.* No. II., for 1897).

Sachs, E. O. What is fire protection? A study by. Pp. 37.

Fire prevention, some American opinions on. Pp. 16.

Sachs, E. O. Paris Charity Bazaar Fire. A paper by. Pp. 52.

(Publications of the British Fire Prevention Committee, Nos. 1, 2, and 3.)

Spring, W. Sur le role des composés ferriques et des matières humiques les phénomène de la coloration des eaux et sur l'élimination

de ces substances sous l'influence de la lumière solaire. Bruxelles 1897.

Observations sur l'hydrolyse du chlorure ferrique. Leide 1897.

Sur le spectre d'absorption de quelques corps organiques incolores et ses relations avec la structure moléculaire. Bruxelles 1897.

Sur la couleur et le spectre d'absorption de quelques corps organiques. Genève 1896.

De la température à laquelle les courants de convection commencent à produire l'opacité d'une colonne d'eau d'une longueur donnée. Bruxelles 1896.

Sur la transparence des solutions des sels incolores. Genève 1896.

De l'influence du temps sur l'agglutination de la craie comprimée. Bruxelles 1895.

Sur la couleur des alcools comparée à la couleur de l'eau. Genève. 1896.

Sur le role des courants de convection calorifique dans le phénomène de l'illumination des eaux limpides. Genève 1896.

Sur un hydrate de trisulfure d'arsenic et sa décomposition par la compression. Bruxelles 1895.

Spring, W., et Romanoff, L. Sur la solubilité réciproque du bismuth et du plomb dans le zinc existence d'une température critique. Bruxelles 1896.

Spring W. Uber die physikalischen veränderungen, die gewisse schwefelverbindungen unter dem einfluss der temperatur erleiden. Leipzig 1895.

Notice bibliographique. Bruxelles 1896.

Woods, Hugh. Æther, its nature and place in the universe. London 1898.

At the next meeting, on Thursday, March 17th, the following papers will be communicated.

"The reduction of bromic acid and the law of mass action." By Winifred Judson, B.Sc., and J. Wallace Walker, M.A., Ph.D

"The action of ferric chloride on the ethereal salts of ketone acids." By R. S. Morell, M.A., Ph. D., and J. M. Crofts, B.A., Ph.D.

"Note on the volatility of sulphur." By T. C. Porter.

"Action of ammonia and substituted ammonias on acetylurethane." By George Young, Ph.D., and Ernest Clark.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 23/3/1898.

PROCEEDINGS
OF THE
CHEMICAL SOCIETY.
EDITED BY THE SECRETARIES.

No. 191. Session 1897–8.

March 17th, 1898. Professor Dewar, F.R.S., President, in the Chair.

Messrs. A. J. Buller Cooper, J. Murray Crofts, R. S. Morrell, T. Cunningham Porter, F. F. Renwick, and Harold C. Sayer were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Oscar Julian Steinhart, Ph.D., 4, Palace St. Mansions, S.W.; Samuel A. Tucker, Ph.D., Columbia University, New York; Ernest Witham, The Grammar School, Rotherham.

ANNOUNCEMENT BY THE COUNCIL.

The PRESIDENT announced that notice of the following resolutions to be proposed at the Annual General Meeting by Messrs. Hartog and Harden had been received:—

RESOLUTION I.

"That in order to carry out the suggestion of Mr. Cozens-Hardy, Q.C., communicated by the Council to the Society at the meeting held on February 17th, 1898 (*Proc.*, 1898, **14**, 38) the following steps shall be taken to ascertain the wishes of the whole Society with regard to the desirability of obtaining a Supplemental Charter for the purpose of enabling Fellows to record their votes at the Annual election of the Officers and other members of the Council by proxy or post.

(1) "The following papers shall be printed and distributed to the Fellows of the Society not later than April 14th :—

(*a*)

"THE CHEMICAL SOCIETY,
BURLINGTON HOUSE,
PICCADILLY, LONDON, W.

"DEAR SIR,—In accordance with the resolution passed at the General Meeting of the Chemical Society held on March 31st, 1898, we are instructed to request you to be good enough to—

"(i) Answer the question printed below, by writing 'Yes' or 'No' in the space marked for the purpose.

"(ii) Fold this paper with the blank side outermost, place it in the envelope 'A' provided, close the envelope, and write your signature legibly *outside*.

"(iii) Enclose the envelope 'A' in the stamped envelope 'B,' and return this by post to the Secretaries on or before May 14th next.

"We are, faithfully yours,
"(Signatures of Secretaries).

"Are you in favour of the proposal that a Supplemental Charter should be applied for to the Privy Council so as to enable Fellows to vote at the annual election of the Officers *by post or proxy?*

"(Here write 'Yes' or 'No').

(*b*)

"An envelope marked thus :—

"THE CHEMICAL SOCIETY. *Re* CHARTER.

A.

"Voting Paper.

"Please sign legibly here.....

(*c*)

"An envelope stamped with a penny stamp, and marked thus :—

B.

"*Re Application for Supplemental Charter.*

THE SECRETARIES OF THE CHEMICAL SOCIETY,
BURLINGTON HOUSE,
LONDON, W.

"(2) At the next meeting held after May 14th the envelopes shall be opened and the voting papers placed, without being unfolded, in a

balloting-box, and they shall be counted by a sufficient number of scrutators, to be appointed by the presiding officer. The signatures on the envelopes shall be at the same time checked against an official list of Fellows of the Society, and shall be preserved for a year.

RESOLUTION II.

"If a majority of the votes recorded in accordance with the method prescribed by the foregoing resolution be in favour of an application being made for a Supplementary Charter for the purpose named, the Council shall be, and are hereby instructed, without any further proceedings, to make the necessary application without delay."

To this notice of Resolutions the following reply had been sent:—

CHEMICAL SOCIETY,
BURLINGTON HOUSE, W.
March 17th, 1898.

DEAR SIRS,—The Council have carefully considered the proposed resolutions which you have forwarded to the Secretaries, notifying them that you intend to move them at the Annual General Meeting.

We are, in the first place, to point out that the effect of passing such resolutions would be precisely the same as passing a bye-law to enable Fellows to vote by proxy or through the post on this question, and that Mr. Cozens-Hardy, Q.C., has already advised that any such bye-law would be repugnant to the Charter.

We are directed to say that this of itself would be sufficient to make the proposed resolutions out of order, but there are other grounds on which the Council are advised that such resolutions cannot be submitted to a General Meeting.

The Council are advised that in view of the opinions of Mr. Cozens-Hardy, such resolutions would not be in order, because they propose to deal with a question which is outside the scope of matters which can be decided at a General Meeting of the Society.

They are also advised that even if such resolutions were passed they would have no power to act upon them, because in considering whether the Fellows really desire the change proposed, regard must not be had only to those who are present in person at a meeting (and still less to a bare majority of Fellows voting, as you propose), but to the wishes of the whole body of the Fellows. You will remember that Mr. Cozens-Hardy thinks that an application for a Supplemental Charter would probably not be listened to unless it represented the practically unanimous view of the Fellows, and that any active opposition by even a small minority would probably be fatal.

The Council are further advised that it would be *ultra vires* to expend any part of the funds of the Society in giving effect to the proposed resolutions or in applying for a Supplemental Charter.

In these circumstances, we are directed to inform you that it would be the President's duty to refuse to put such resolutions to the meeting.

We are also to point out that it would be open to any Fellows of the Society, at their own expense, to send out the circulars referred to in the resolutions, and that if it should be found that the Fellows were practically unanimous in desiring that application should be made for a Supplemental Charter, this could be applied for by them at the like expense, and that in the event of there being no opposition Her Majesty might be pleased to direct that such expenses should eventually be paid out of the funds of the Society.

We are, dear Sirs,

Your obedient Servants,

JOHN M. THOMSON, } *Honorary*
WYNDHAM R. DUNSTAN, } *Secretaries.*

ARTHUR HARDEN, ESQ.
P. J. HARTOG, ESQ.

Of the following papers those marked * were read :—

***34. "The reduction of bromic acid and the law of mass action." By Winifred Judson, B.Sc., and J. Wallace Walker, M.A., Ph.D.**

The authors have investigated the velocity of the reduction of bromic acid by hydrobromic acid, and find that, in the presence of a large quantity of sulphuric acid, the reaction is bimolecular, whereas in the absence of sulphuric acid it is tetramolecular. The results are in agreement with the conclusions drawn by Noyes (*Zeit. Phys. Chem.*, 1896, 19, 599) from the experiments of himself and others on the reduction of bromic acid by hydriodic acid. The explanation put forward is that the stage of the reaction, which requires a measurable time for its completion, is expressed by the equation $2\overset{+}{H} + \overset{-}{Br} + \overset{-}{BrO_3} = HBrO + HBrO_2$, and that the bromous and hypobromous acids are instantly decomposed by the hydrobromic acid present. A further result obtained is that the reduction of bromic acid by hydriodic acid takes place 58·5 times faster than by hydrobromic acid, and that, therefore, although the latter is produced from bromic by hydriodic acid, its presence in no way vitiates the conclusions drawn by Noyes from that reaction.

***35. "The action of ferric chloride on the ethereal salts of ketone acids." By R. S. Morrell, M.A., Ph.D., and J. M. Crofts, B.A., B.Sc.**

When anhydrous ferric chloride dissolved in absolute ether is added to an ethereal solution of ethylic ketophenylparaconate, a red oil separates. This, when washed with absolute ether, becomes solid, and is, most probably, represented by the formula, $FeCl_2(C_{13}H_{11}O_5)$. Water decomposes the compound with formation of the basic ferric salt of ethylic ketophenylparaconate, $Fe(OH)(C_{13}H_{11}O_5)_2$, and ferric chloride.

The ethylic salt of the lactone of oxalcitric acid yields with ferric chloride in absolute ether solution a red oil, which does not solidify, and is most probably an addition product, represented by the formula $FeCl_3,C_{14}H_{18}O_9$. It loses hydrochloric acid slowly in a vacuum. On treatment with water, it yields the ferric salt of the lactone of ethylic oxalcitrate, $Fe(C_{14}H_{17}O_9)_3$, and ferric chloride.

In the case of ethylic acetoacetate and ethylic benzaldiacetoacetate purple oils are obtained by the action of anhydrous ferric chloride. The purple substances have not as yet been prepared in a sufficiently pure state to justify the authors in assigning formulæ to them.

***36. "Note on the volatility of sulphur." By T. C. Porter, M.A., &c.**

During the analysis of some pumice rock from Tenerife, the author was led to the conclusion that sulphur is volatile at 100°. Several glass tubes were carefully cleaned, into which specimens of sulphur of varying physical condition and purity were placed. Some of the tubes were exposed to the air, others were exhausted. After being exposed to a temperature of 100° for some minutes, it was observed that, as was to be expected, the better the vacuum, the more rapid is the sublimation of the sulphur. The sublimate consists at first of very pale yellow drops, which possess little viscosity, and remain unchanged in some cases even at 10° for days. Rhombic octahedra and prismatic sulphur are occasionally formed together, the former crystals sometimes grow at the expense of the drops. Sulphur does not yield a perceptible sublimate at ordinary temperatures, in a "good vacuum," even after a year. The two forms S_α and S_β therefore have their transition point between 90° and 100°.

Discussion.

Professor McLeod said that about 1870 Mr. Douglas Herman had experimented on the volatility of various substances in vacuous tubes, although he believed the results have never been published. Mr.

Herman found that sulphur could be volatilised in a vacuum when heated to the temperature of boiling water, and that the vapour condensed in drops on the cool parts of the tube, and remained liquid for many days. Octahedral crystals were formed at the expense of the drops in the neighbourhood of the crystals, the drops gradually evaporating whilst the crystals increased in size; prismatic crystals were very rarely seen. When phosphorus is heated in vacuo by the warmth of the hand, its vapour also is deposited in drops, although, as in the case of sulphur, the vapour had not been heated to the melting point of the solid. Iodine at once forms crystals under similar conditions, no liquid being deposited.

The PRESIDENT said that, in a lecture on liquid atmospheric air in 1893 (*Proc. Roy. Inst.*, 14, 7), he had described the use of sulphur in the construction of vacuum vessels for the storage of liquid air, and had shown that in such vacua cooling with liquid air or oxygen was sufficient to produce a visible distillation of sulphur at ordinary temperatures. The vapour tension of sulphur at 100° amounts to 0·06 mm., so that the tension is comparatively high in Mr. Porter's experiments, considering that mercury distils rapidly under a pressure of one-millionth of an atmosphere, as shown by the application of liquid air. He also remarked that phosphorus distils practically instantaneously.

*37. "Cannabinol." By T. B. Wood, M.A.; W. T. N. Spivey, M.A.; and T. H. Easterfield, M.A., Ph.D.

The authors have continued their examination of cannabinol, the toxic resinous constituent of Indian hemp (*Trans.*, 1896, 69, 539). The substance boils with slight decomposition at about 400°, its absorption spectrum shows no characteristic bands, its vapour-density at the temperature of boiling sulphur corresponds with the formula $C_{18}H_{24}O_2$, already assigned to the compound.

An account is given of the reaction of cannabinol with acetic anhydride, benzoyl chloride, and phosphoric anhydride; the results indicate that one hydroxyl group is present. In the case of acetic anhydride or acetyl chloride, however, a crystalline compound melting at 75° is one of the products of the reaction. The authors assign the formula $C_{15}H_{18}O_2$ to this compound. The same compound has recently been described by Dunstan and Henry (*Proc.*, 1898, 14, 44, Feb. 17) who ascribe the formula $C_{18}H_{23}OAc$ to it. Fuming hydriodic acid gives no methyl or ethyl iodide when boiled with cannabinol. Reduction with hydriodic acid in sealed tubes produces a hydrocarbon, $C_{10}H_{20}$.

By long-continued boiling with or without dehydrating agents, a hydrocarbon, $C_{10}H_{16}$, is formed.

Oxidation with aqueous chromic acid, alkaline, or acid permanganate, or dilute nitric acid is accompanied by the production of a caproic acid, lower fatty acids being probably produced at the same time. The action of fuming nitric acid upon cannabinol dissolved in cold glacial acetic acid removes one carbon atom as carbonic anhydride, and produces a red, amorphous substance which gives numbers on analysis agreeing with the formula $C_{17}H_{20}N_2O_6$. This substance, when boiled with nitric acid, yields a light red substance, $C_{17}H_{20}N_2O_8$, which upon further oxidation yields, amongst other substances, a yellow acid crystalline compound, $C_{13}H_{15}N_2O_5$ which forms sparingly soluble crystalline sodium, ammonium, and silver salts and is probably a dinitrophenol, and a compound, $C_{11}H_{11}NO_4$, the properties of which agree closely with those of the "oxycannabin" of Bolas and Francis (*Chem. News*, 1871, **24**, 77). This compound has the properties of a nitro-lactone, as has been already shown by Dunstan and Henry (*Proc., loc. cit.*). Corresponding crystalline potassium and silver salts have been prepared and analysed. The name cannabinic acid is proposed for the unnitrated parent oxy-acid.

Amido-cannabinolactone, $C_{11}H_{11}O_2NH_2$, is obtained in colourless crystals melting at 119°, when the nitro-lactone is reduced either by hydriodic acid or by tin and hydrochloric acid. The base is readily recrystallised from hot water, its salts cannot be recrystallised from water without decomposition; the hydriodide and platinochloride have been analysed.

*38. "Contributions to the chemistry of thorium." By Bohuslav Brauner, Ph.D.

As there are few direct methods of separating the elements of the rare earths, the author investigated the reaction of Bahr (1864), who showed that thorium oxalate is easily soluble in a solution of ammonium oxalate. Bunsen (1876), though he found that the oxalates of the other rare earths are only slightly soluble in that reagent, had to repeat the process of solution many times to obtain a product which did not show in its spark spectrum the lines of other elements.

The reaction is due to the formation of a double thorium-ammonium oxalate, decomposed by water, and existing in solution only in the presence of free ammonium oxalate. After numerous crystallisations, a salt was obtained having the formula $Th(C_2O_4)_2 + 2(NH_4)C_2O_4 + 4H_2O$, with one-third to one-half of free $(NH_4)_2C_2O_4 + H_2O$. Finding, however, that the solution readily becomes supersaturated, a compound having the formula $Th(C_2O_4)_2 + 2(NH_4)C_2O_4 + 7H_2O$, was obtained in such a high state of purity that from its analysis the atomic weight of thorium, Th = 232·59, could be calculated.

This "complex" salt is ammonium thoroxalate. It is decomposed by water, but a definite quantity of the soluble product of decomposition dissolves the insoluble constituent, so that one part of water keeps one part of ammonium thoroxalate in solution if an additional half-molecule of free ammonium oxalate is present. The salt forms two hydrates, in accordance with Potilizin's law that a compound forming supersaturated solutions exists in several hydrate forms, one with $7H_2O$, the other with $4H_2O$. The former loses water in air of average humidity, passing into the latter form, which becomes anhydrous in perfectly dry air, or more readily at 100°, without loss of ammonia. On heating at higher temperatures, large quantities of cyanogen gas are evolved.

The amount of the decomposition of the salt caused by increasing the quantity of water was determined, together with the proportion of ammonium oxalate required to prevent decomposition. Three mols. of ammonium oxalate form, with one mol. of thorium oxalate, a clear solution in 300 mols. of water. This solution is, however, supersaturated with thorium oxalate, the latter separating until their relative proportions become 3·3 : 1. A convenient method for the purification of thorium may be based on these results, as the author has determined quantitatively the great difference in solubility between the oxalate of the feebly basic tetravalent thoria and those of the other trivalent rare earths in ammonium oxalate. The rule was thus established: "the tendency to form complex oxalates is inversely proportional to the basicity of an earth." This, and another property of oxalates, that their stability under the oxidising action of nitric acid decreases considerably with an increasing basicity of the earth, was utilised for the purification of thorium.

On precipitating a solution of ammonium thoroxalate with oxalic acid, an acid thorium oxalate—thoroxalate of thorium and hydrogen—is formed, having the formula $H_2Th_2(C_2O_4)_5 + 9H_2O$. On using mineral acids (Glaser, *Zeit. Anal. Chem.*, 1897, **36**, 216; 1898, **37**, 25), a different result is observed.

***39. "On the atomic weight of thorium." By Bohuslav Brauner, Ph.D.**

The author determined the purity of the material, obtained as described above, by the spark spectrum, and by atomic weight determinations. He determined in the air-dry oxalate (*a*) the thorium tetroxide by heating, and (*b*) the percentage of C_2O_3 by means of a solution of potassium permanganate. The first series of experiments gave concordant results, leading to the value Th = 233·3, a value not in agreement with that previously obtained by him, Th = 232·59.

Further study showed that the oxalate used was contaminated with basic salt, and a normal oxalate being prepared, the following values were obtained as a result of five series of experiments made with different preparations. Th = 232·50, 232·46, 232·45, 232·31, 232·33, 232·50, 232·44, and 232·35 ; average, Th = 232·42.

This number agrees with that obtained by Krüss and Nilson, Th = 232·45. The author then investigates the conditions which led him to obtain the high value in the first series, approaching the value of Cleve, Th = 234·5. The work of other investigators is vitiated by untrustworthy methods and impure material.

***40. "On the compound nature of cerium." By Bohuslav Brauner, Ph.D.**

The author showed in 1882 (*Trans.*, 41, 68 ; *Monats.*, 3, 486) that cerium from cerite is associated with an element whose higher oxide forms yellow and lower white salts, though the higher oxide is far less stable than cerium tetroxide. The substance is found with lanthanum and didymium when separating cerium by Bunsen's method. In 1885, the author showed (*Trans.*, 47, 879) that the substance remains in the mother liquor after the bulk of the cerium sulphate has crystallised, and may be precipitated from it by alcohol. Schützenberger has repeated the author's experiments without mentioning his name. After applying Debray's method of separating cerium to these fractions and again fractionating, the author obtained substances with the following values for the atomic weights. The method employed was the analysis of the oxalate, and the determination of 'active' ozonic oxygen by Bunsen's method in the oxide obtained by calcination, the latter number being given in parenthesis: $R''' = 140·25$ (4·64), 140·22 (4·65), 140·12 (4·81), 140·00 (4·65), 140·01 (4·59), 139·65 (4·61), 139·16 (4·01), 138·72 (4·51), 136·50 (3·31), 135·43 (3·93), 132·07 (3·73), 130·70 (3·21). As the value of the atomic weight decreases, the colour changes from white to a reddish-brown orange.

The quantity of 'active' oxygen, therefore, decreases almost in proportion to the decrease in value of the atomic weight. If we assume that the 'active' oxygen is due entirely to the cerium present, the value of the atomic weight of the other element may be calculated at about 110. The author has thoroughly investigated the spark spectrum of the lower fractions, but has found no characteristic line, other than those of cerium. In one case only were traces found of the two characteristic groups of lines in the red belonging to yttrium. No appreciable amount of yttria could be found, however, in the solution, even when a large quantity of the material in question was treated with potassium sulphate. As terbium forms a higher

oxide of an orange colour, the colour of the lower fractions of cerium may be due to its presence, but as its atomic weight is higher than that of cerium, another earth of lower atomic weight must still be present, and it is not improbable that, like gadolinum, this element may give no characteristic spectrum. The recent controversy between Wyruboff and Boudouard (*Compt. rend.*, 1897, **125**, *pass.*) has led the author to publish the result of this research, which has occupied him many years.

***41 "On praseodidymium and neodidymium." By Bohuslav Brauner, Ph.D.**

Applying Mendeléef's method of crystallisation of the double nitrates with ammonium nitrate to a mixture of lanthanum and didymium, Auer von Welsbach (1885) succeeded in splitting up the old didymium into "praseodym" and "neodym." Praseodidymium, according to him, has an atomic weight Pr = 143·6, and forms two oxides, Pr_2O_3 and Pr_4O_7. The higher oxide is black-brown, the lower forms green salts with a characteristic spectrum. Neodidymium Nd = 140·8 gives only one oxide, Nd_2O_3 with pink salts possessing eleven absorption bands. Nothing of importance has been added to our knowledge on the subject during the last 11 years.

The author spent several years in repeating Welsbach's work, but last year he obtained from Dr. Waldron Shapleigh, in Gloucester, N.J., a quantity of highly purified research material.

From this mixture (40 grams of praseodidymium oxide with 20 grams of lanthanum oxide) the latter was removed, the former being converted by fusion with nitre into the oxide Pr_2O_4. This was purified by fractionating with ammonium nitrate solution, ammonia, and oxalic acid.

A preliminary determination of the atomic weight gave the value Pr = 140·8. The analysis of the oxalate and the synthesis of the sulphate gave thirteen numbers, varying between 140·84 and 141·19, the average being Pr = 140·95. The lower oxide, Pr_2O_3, is of a beautiful pale green colour, and the spectrum of its green salts contains the absorption bands $\lambda = 5968$, 5895, 4812, 4693 and 4447 (Rowl.) Praseodidymium trichloride gives a characteristic spark spectrum.

Salts of the trioxide having the following formulæ have been prepared and analysed by the author:—$Pr_2(SO_4)_3$, $Pr_2(SO_4)_3 + 6H_2O$, $Pr_2(SO_4)_3 + 8H_2O$, $Pr(NO_3)_3 + 2NH_4NO_3 + 4H_2O$, $PrAc_3 + H_2O$, $Pr_2(C_2O_4)_3 + 10H_2O$.

According to Professor Vrba's measurements, the salt $Pr_2(SO_4)_3 + 8H_2O$ is isomorphous with $Y_2(SO_4)_3 + 8H_2O$ and other sulphates of this type. This fact, and the slight solubility of the oxalate in ammonium oxalate,

prove that the formula of the lower oxide is Pr_2O_3, and not Pr_2O_4 or Pr_2O_5, in which cases the atomic weight would be 188 or 235. The tetroxide, Pr_2O_4, obtained from the nitrate on heating to a temperature of 440°, or by fusion with nitre at 400°, is jet-black, but it becomes dark brown in a state of fine division.

Up to the present, only its basic salts have been obtained; the sulphate, $2Pr_2O_4 \cdot SO_3 + 2\frac{1}{2}H_2O$, and the basic acetate in acetic acid solution, having a formula which may be represented by either $Ac_3—Pr^{IV}O—Pr^{IV}—(OH)_3$, or $Ac_2—Pr^{III}{}_2O_2—OH \cdot Ac + H_2O$. The double fluorides are being investigated.

It is of the greatest importance to know whether the tetroxide is (*a*) a true oxide of the water type, with ozonic oxygen (like lead tetroxide, PbO_2), in which case the praseodidymium would be tetravalent, or (*b*) a true peroxide of the hydrogen peroxide type, with antozonic oxygen (like barium peroxide, BaO_2), in which case the metal would be trivalent. With regard to the first view, it yields, with dilute acids, free oxygen, and the solution does not reduce potassium permanganate (negative test for hydrogen peroxide). On treatment with concentrated nitric and sulphuric acids, oxygen containing much ozone is evolved, and with hydrochloric acid chlorine is set free, arising probably from the decomposition of the unstable perchloride, $PrCl_4$ (?). Like other ozonic oxides of the water type, it presents with hydrogen peroxide the phenomenon of catalysis in the presence of dilute sulphuric acid, a quantity of the hydrogen peroxide being oxidised, strictly equivalent to the 'active' oxygen lost by praseodidymium tetroxide according to the equation: $Pr_2O_4 + H_2O_2 + 3H_2SO_4 + Aq = Pr_2(SO_4)_3 + O_2 + 4H_2O + Aq$.

On the other hand, praseodidymium tetroxide gives with ether, water, sulphuric acid, and potassium bichromate an intensely blue coloration (Baresville's reaction) according to the equation $Pr_2O_4 + 3H_2SO_4 + Aq = Pr_2(SO_4)_3 + H_2O_2 + 2H_2O + Aq$. In the treatment, therefore, of the tetroxide with dilute sulphuric acid both reactions take place simultaneously, and the result is the evolution of oxygen, $2Pr_2O_4 + 6H_2SO_4 + Aq = 2Pr_2(SO_4)_3 + O_2 + 6H_2O + Aq$.

Praseodidymium tetroxide is, therefore, an oxide of a new kind, belonging simultaneously to the ozonic oxides of the water type, and to the antozonic oxides of the hydrogen peroxide type; it is, in fact, the missing link between these two hitherto entirely different types of peroxides, its active oxygen being at the same time both entirely ozonic and entirely antozonic.

The basic acetate of the tetroxide, which is nearly white, and in the spectrum of which the blue absorption bands are invisible when seen by reflected light, though the yellow band remains unchanged (an indication of the complex nature of praseodidymium), is the salt of an

oxide belonging to the hydrogen peroxide type, for it reduces potassium permanganate quantitatively and gives Baresville's reaction for hydrogen peroxide. It is, however, so remarkably stable that it does not part with all its active oxygen even after being boiled for an hour with concentrated caustic potash solution.

As regards the author's neodidymium, its absorption spectrum contains the bands $\lambda = 7283$, 7080, 6905, 6368, 6279, 6247, 5788, 5323, 5211, 5097, 5063 and 4280. It contains, in addition to these, a strong, sharp band of wave-length $\lambda = 4694$ which differs in character and position from the praseodidymium band $\lambda = 4693$. There were also traces of Pr 4812 and Pr 4447, Dy 4752 and 4605 (Sm. series ?).

The value of the atomic weight of neodidymium found after the first purification of the material by treatment with oxalicacid was Nd = 143·4, after another purification, Nd = 143·63. Its lower oxide, having the formula Nd_2O_3, is of a beautiful pink colour with an amethyst tint, whereas the higher oxide contains a little more oxygen than corresponds to the formula Nd_2O_5 (the author's old Di_2O_5). Neodidymium also gives two series of salts, the acetate of the higher oxide being nearly white. According to a quantitative analysis, by comparing the intensity of the bands the author's neodidymium contained 2·9 per cent. praseodidymium, whereas the old didymium from cerite contained in 100 parts of the oxide 78·8 parts Nd_2O_3 and only 21·2 per cent. Pr_2O_3.

With regard to the position of these elements in the periodic system, the author concludes from the tendency of them both to become more highly oxidised than would correspond to the formulæ Pr_2O_4 and Nd_2O_5, that praseodidymium and neodidymium may be further split up. This is regarded as very probable by all rare earth chemists. The pure oxides will probably be found to have the formulæ Pr_2O_5 and Nd_2O_6, so that the eighth series of the periodic system would assume the following form :—

I	II	III	IV	V	VI
Cs.	Ba.	La.	Ce.	Pr.	Nd.
133	137·4	138·2	139·7	141	143·6

Discussion.

The President congratulated Professor Brauner on the valuable scientific results he had presented to the Society, and on behalf of the members expressed their appreciation of the motives which had induced the author to come all the way from Prague to communicate four papers of such great importance to the Chemical Society. He wished him success in the continuation of such laborious and intricate investigation.

42. "Action of ammonia and substituted ammonias on acetylurethane." By George Young, Ph.D., and Ernest Clark.

Acetylurethane has been subjected to the action of ammonia and of substituted ammonias under varying conditions as to solvent, temperature, and pressure. The general results of the investigation show that action takes place principally according to the equation, $MeCONHCO_2Et + NH_2R = MeCO \cdot NH \cdot CO \cdot NHR + EtOH$. Under certain conditions, the products point to the action having resulted in the formation of acetamidine urethanes, $MeCO,NHCO_2Et + NH_2R = Me(NHR)C:N \cdot CO_2Et + H_2O$. These acetamidines have not been isolated, but in their place the products of hydrolysis, acetamide and substituted acetamides, have been obtained, $Me(NHR)C:N \cdot CO_2Et + 2H_2O = Me \cdot CO \cdot NHR + NH_3 + CO_2 + EtOH$. Ammonia and methylamine enter into action most easily, piperidine, aniline, the naphthylamines and phenylurea less so. Acetylurea, acetanilide, and diphenylamine appear to be without action.

43. "Formation of oxytriazoles from semicarbazides." By George Young, Ph.D., and Benjamin Mitchell Stockwell, B.Sc.

This paper contains an account of the formation of oxytriazoles according to the equation $R \cdot NH \cdot NH \cdot CO \cdot NH_2 + C_6H_5 \cdot CHO + O = R(C_6H_5) \cdot C_2N_3OH + 2H_2O$ where R is an aromatic radicle. The following substances are described. *Paratolylsemicarbazide*, m. p. 187—188°. *Acetylparatolylsemicarbazide*, m. p. 212·5°. *Benzoylparatolylsemicarbazide*, m. p. 218°. *Paratolylazocarbamide*, m. p. 142°. *5-Phenyl-1-paratolyl-3 oxytriazole*, m. p. 242°. *Acetylphenylparatolyloxytriazole*, m. p. 112—113°. *Benzoylphenylparatolyloxytriazole*, m. p. 132°. *Phenylparatolylethoxytriazole*, m. p. 51—52°. *β-Naphthylsemicarbazide*, m. p. 225°. *Phenyl-β-naphthyloxytriazole*, m. p. 274—275°. *Acetylphenyl-β-naphthyloxytriazole*, m. p. 142—143°. *Benzoylphenyl-β-naphthyloxytriazole*, m. p. 141—142°. *Metanitrophenylsemicarbazide*, m. p. 195°. *Benzoylmetanitrophenylsemicarbazide*, m. p. 188—189°. *Metanitrophenylazocarbamide*, m. p. 168—169°. *5-Phenyl-1-metanitrophenyl-3-oxytriazole*, m. p. 235°. *Acetylphenylmetanitrophenyloxytriazole*, m. p. 130—132°. *Benzolymetanitrodiphenyloxytriazole*, m. p. 168°. *Nitrodiphenylethoxytriazole*, m. p. 96°.

44. "Formation of αα′-dihydroxypyridine." By S. Ruhemann, Ph.D., M.A.

Ethylic αα′-dihydroxydinicotinate (*Proc.*, 1898, **14**, 47) when boiled with concentrated hydrochloric acid, yields the hydrochloride of αα′-dihydroxypyridine, from which ammonia sets free the base (m. p.

192—193°). The same substance is obtained from Guthzeit and Dressel's monethylic ethoxypyridonedicarboxylate (*Annalen*, 1891, 262, 113) by boiling hydrochloric acid.

45. **"Position-isomerism and optical activity; the comparative rotatory powers of diethylic mono-benzoyl and mono-toluyl tartrates." By Percy Frankland, F.R.S., and J. McCrae, Ph.D.**

The authors review the present state of knowledge concerning the relative rotatory powers of the phenyl and three toluyl derivatives of optically active compounds, and point out that whilst of the three isomeric toluyl groups, the ortho- has almost invariably the least, and the para- the greatest, rotatory influence, the rotatory influence of the phenyl-group is in some series greater, and in some less, than that of any one or of all of the toluyl groups.

As a contribution to this study, the authors have prepared the compounds mentioned above, and have determined their rotations in a fused state over a wide range of temperature, whilst they have also determined the molecular weight and rotation of each in glacial acetic acid solution, with a view of ascertaining the relative rotations of the compounds in the monomolecular condition.

The following are the specific rotations at 100° for each of the compounds, as well as of diethylic tartrate, from which they may be regarded as derived.

Diethylic tartrate.....	$[\alpha]_D^{20°} = +7{\cdot}66°$	$[\alpha]_D^{100°} = +15{\cdot}77°$
„ monobenzoyltartrate..	$[\alpha]_D^{24°} = +20{\cdot}71°$	$[\alpha]_D^{99{\cdot}5°} = +17{\cdot}69°$
„ mono-*o*-toluyltartrate.	$[\alpha]_D^{20°} = +11{\cdot}82°$	$[\alpha]_D^{100°} = +10{\cdot}88°$
„ „ *-m-* „	$[\alpha]_D^{20°} = +13{\cdot}59°$	$[\alpha]_D^{100°} = +12{\cdot}57°$
„ „ *-p-* „		$[\alpha]_D^{100°} = +15{\cdot}85°$

Thus the dextrorotation of diethylic tartrate increases with rise of temperature, whilst that of the above monacidyl tartrates diminishes. In glacial acetic acid solution, the benzoyltartrate has a lower rotation than the para-toluyltartrate, but otherwise the above order of the rotations is unchanged. In all cases the rotation in glacial acetic acid solution was considerably lower than that of the pure substance, but this difference is not attributable to the pure substance in the fused state being associated, for the rotation of the diethylic monobenzoyltartrate in benzene solution was even lower still, and yet in benzene solution it is more probable that there would be association than in glacial acetic acid. Thus from the results in benzene it would appear that association of the benzoyl compound is attended with diminution in the rotation, so that the higher rotation of the liquid benzoyl compound itself cannot

be due to association also. Neither do the molecular volumes of these compounds point to association when interpreted by Traube's formula.

Diethylic monobenzoyltartrate has been previously prepared by Guye and Fayollat (*Bull. Soc. Chim.*, 1895, [iii], 13, 201), their preparation was admittedly impure, and yielded a very much lower rotation and melting point. It was first prepared by Perkin (*Trans.*, 1867, 20, 138), but without determining the rotation, the melting point which he obtained was almost exactly the same as that found by the authors.

46. "The action of di-isocyanates upon amido-compounds." By H. Lloyd Snape, D.Sc., Ph.D.

By the action of diphenylenedi-isocyanate upon phenylhydrazine in ethereal solution, *diphenylenedi-phenylsemicarbazide*, $Ph{\cdot}NH{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}C_6H_4{\cdot}C_6H_4{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}NH{\cdot}Ph$, was obtained. The product was a white powder which was insoluble in the more common organic solvents. It gave with copper sulphate a chocolate-brown colour, which was changed to green on the addition of ammonia.

Toluylenedi-phenylsemicarbazide, $Me{\cdot}C_6H_3(NH{\cdot}CO{\cdot}NH{\cdot}NH{\cdot}Ph)_2$, (1 : 2 : 4) was prepared by acting with 1 : 2 : 4-toluylenedi-isocyanate on an ethereal solution of phenyl-hydrazine. The product, after recrystallisation from alcohol, consisted of colourless crystals which decomposed and rose in a capillary tube at 203°. This carbazide also was insoluble in the more common organic solvents, with the exception of alcohol, in which it was difficultly soluble. With copper sulphate, it gave a wine-red coloration which changed to green on the addition of ammonia.

1 : 2 : 4-*Diphenyl-toluylene-diurea*, $Me{\cdot}C_6H_3(NH{\cdot}CO{\cdot}NH{\cdot}Ph)_2$, was obtained on mixing ethereal solutions of aniline and toluylenedi-isocyanate. The product was recrystallised from alcohol; it formed microscopic needles which melted at 261° with accompanying decomposition. It was difficultly soluble in methyl, ethyl, and amyl alcohol.

1 : 2 : 4-*Toluylene-diurea*, $Me{\cdot}C_6H_3(NH{\cdot}CO{\cdot}NH_2)_2$, was prepared by treating an ethereal solution of toluylenedi-isocyanate with ammonia and crystallising the product from water. Minute crystals, which melted with accompanying decomposition at about 252°. It was sparingly soluble in alcohol. Lussy had previously described this reaction, but states that the product melts at 220°.

47. "The action of alkyl iodides on silver malate and on silver lactate." By Thomas Purdie, F.R.S., and G. Druce Lander, B.Sc.

The object of this research was to discover the cause of the abnormally high optical activity of the ethereal malates and lactates pre-

pared by the silver salt method. An abstract of the first part of the paper treating of the action of isopropylic iodide and ethylic iodide on silver malate has already been published as a preliminary note (*Proc.*, 1896, 12, 219). The high activity of the malates, thus prepared, is due to the simultaneous production of ethereal salts of the much more active alkyloxysuccinic acids.

The silver salt of inactive lactic acid acts in a similar manner. With isopropylic iodide, the ethereal salt of (n- or iso-) propoxypropionic acid is produced in considerable quantity. By reactions similar to those employed in the case of silver malate, the substance was separated from the ethereal lactate with which it is mixed, and identified by the analysis of several salts obtained from it. Evidence was also obtained that with ethylic iodide the ethylic salt of ethoxypropionic acid is produced, though in this case, as in the corresponding reaction with silver malate, it was not possible to isolate the salts in the pure state owing to the small quantity of the alkyloxy-acid formed. The authors have recently effected the resolution of several alkyloxypropionic acids by means of alkaloids, and find that these acids are highly active as compared with lactic acid. Their production in the reaction above referred to accounts therefore for the abnormal activity of the ethereal lactates prepared from silver lactate.

The reaction seems to be a general one for the silver salts of hydroxy-acids (see following paper), and cannot therefore be relied on for the preparation of the ethereal salts of these acids in the pure state. With the permission of Mr. Brame, the authors have recently extended his experiments on the action of alkyl iodides on silver tartrate. The results already obtained point to the formation of dialkyloxysuccinates being the cause of the abnormally high activity of the ethereal tartrates thus prepared. The authors are carrying on the research with the view of throwing light on the reaction by which the alkyloxy-acids are produced, and of adapting it, if possible, for the direct preparation of optically active acids of this kind from the corresponding active hydroxy-acids.

48. "On the optical rotations of methyl and ethyl tartrates." By J. W. Rodger and J. S. S. Brame.

The authors, in attempting to prepare the alkyl tartrates in a high state of purity, find that when prepared by saturating an alcoholic solution of the acid with hydrochloric acid, or heating the acid or monosubstituted ester with alcohol in sealed tubes, the rotation of the product is much lower than that obtained for esters prepared by the action of an alkyl iodide on silver tartrate.

Differences of the same nature have been observed by J. Wallace

Walker (*Trans.*, 1895, 67, 914) in the case of the lactates, and by Purdie and Williamson (*Trans.*, 1896, 69, 818) for malates and lactates. With alkyl tartrates, however, the difference in activity is much greater than with lactates or malates. Further, the rotation for different specimens of tartrates prepared by the silver method is by no means constant, although every precaution was taken to ensure similar treatment during preparation.

In order to determine any other differences in the esters prepared by these different methods, samples of methyl tartrate giving these different optical activities were hydrolysed with excess of sodium hydrate, when the products of hydrolysis gave practically the same rotations. Secondly, no difference in the refractive indices was found; and on combustion of methyl and ethyl tartrates prepared by different methods and varying widely in rotation, no real difference in the percentage of carbon could be detected.

These abnormal results for the rotations may be explained on three hypotheses. The low rotation of the ethereal salts prepared by hydrochloric acid saturation or by the sealed tube method may be due to racemisation. Second, the esters from the silver salts may be isomeric with and more active than those prepared by other methods; or third, the esters prepared from silver salts may be contaminated with some much more optically active substance.

The first hypothesis is precluded by the constancy of the rotations obtained by the authors for specimens prepared by three different methods and the agreement with the rotations observed by others with these substances. The second is improbable, but receives some support from the result of hydrolysis. With regard to the third hypothesis, Purdie and Lander in a preliminary note on the action of alkyl iodides on silver malate (*Proc.*, 1896, 12, 221) ascribe the higher rotation given by the malates so obtained to the presence of "small quantities of the ethereal salts of the highly active alkyloxy-acids." The same explanation may hold with the tartrates, in which case these derivatives must be highly active, for they can only be present in small amount, since there is no appreciable rise in the percentage of carbon found. If the high rotation for tartrates prepared from silver salts is due to this cause, then the agreement of results obtained on hydrolysis is only a coincidence.

ANNIVERSARY MEETING.

The Anniversary Meeting will be held on Thursday, March 31st, at 3 o'clock in the afternoon.

At the next Ordinary Meeting, on Thursday, April 21st, there will be a ballot for the election of Fellows.

CERTIFICATES OF CANDIDATES FOR ELECTION.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, April 21st.

Coupe-Annable, Henry William,
University College, Sheffield.

Chemical Assistant. For six years Chemical Assistant to Prof. Williams, University College, Sheffield. Author (jointly with Dr. G. Young) of paper, "Formation of substituted Oxytriazoles from Semicarbazides," *Proc.*, 1897, also paper "Benzoylphenylsemicarbazide," *Trans.*, 1897.

W. Carleton Williams. L. T. O'Shea.
George Young. Fred Ibbotson.
William H. Oates.

Abbott, Albert,
Church Street, Adlington, Chorley, Lancashire.

Schoolmaster. B.A., Oxford. First Class in Chemistry in Final Honour School. Formerly Science Master at the Marling School, Stroud; for last 2½ years Science Master at the Grammar School, Doncaster.

J. Mitchell Wilson. John Watts.
V. H. Veley. J. E. Marsh.
W. W. Fisher. *John William Young.*

Baskerville, Charles, B.S., Ph.D.

University of North Carolina, Chapel Hill, N.C.

Assistant Professor of Chemistry Univ. of North Carolina, Assist. Chemist to North Carolina Geolog. Survey. Grad. in Chem. Univ. of Va, P.G.Student Vanderbilts University. Studied in 1893 under Dr. Emil Fischer, Univ. of Berlin. Ph.D., Univ. N.C. 1894. Instructor in, then Assist. Prof. of Chem. Univ. of N.C., Secy. Section C. Am. Assist. of Adv. Science. Author "Separation of Zirconium by SO_3," "Rapid Method Determination P. in Titaniferous Iron Ores," "Reactions between Copper and H_2SO_4," "Reaction between Mercury and H_2SO_4," and others. Co-author with Dr. F. P. Venable, "Sulphites of Zirconium," "Zirconium Oxalates," &c.

J. W. Mallet. W. L. Dudley.
F. P. Venable. Marcus Benjamin.
F. P. Dunnington. Jas. Lewis Howe.

Brierley, Joseph,

Ashton Road, Failsworth, Manchester.

Assistant Lecturer in Chemistry at the Technical College, Huddersfield. B.Sc. (Victoria) Associate of The Owens College.

Harold B. Dixon. G. H. Bailey.
J. H. Wolfenden. S. G. Rawson.

W. H. Perkin, junr.

Campion, Alfred,

637, Alexandra Parade, Dennistoun, Glasgow.

Chemist to Steel Co. of Scotland, Ltd., Blochairn Works, Glasgow. Three years' training at Finsbury Technical College, London. Chemical Lecture Assistant for 3½ years at R.I.E. College, Cooper's Hill, Staines. At present Chemist at Blochairn Steel Works. Associate of the Institute of Chemistry.

R. Meldola. Herbert McLeod.
J. E. Stead. F. E. Matthews.

F. W. Harbord.

Caven, Robert Martin,

University College, Nottingham (private address—The Tower House, Park Row, Nottingham).

Lecturer and Demonstrator in Chemistry. B.Sc. Lond., F.I.C. For upwards of two years Assistant in the Laboratory of the City Analyst, Birmingham. Since September, 1895, Lecturer and Demonstrator in Chemistry, Nottingham. Author of the following papers: January, 1896, *J.S.C.I.*, "On some Properties of Ferric Phosphate."

January, 1897, *J.S.C.I.*, "Some Properties of Certain Metallic Phosphates," in conjunction with A. Hill. November, 1897, *Proc.*, "The Action of Magnesium on Cupric Sulphate Solution," in conjunction with F. Clowes, D.Sc. December, 1897, *J.S.C.I.* "The Estimation of Cuprous Oxide by means of Standard Potassium Permanganate Solution," in conjunction with A. Hill.

Frank Clowes. F. Stanley Kipping.
Alfred Hill. J. J. Sudborough.
William A. Tilden. L. Archbutt.

Hudson-Cox, Fredk.,
67, Surrey Street, Sheffield.

Analytical Chemist. For three years a Student of Chemistry at the School of the Pharmaceutical Society, and for one year a Student of Physics at University College, London. Associate of the Institute of Chemistry. Assistant to Mr. A. H. Allen.

Wyndham R. Dunstan. Arthur P. Luff.
Thos. Stevenson. Alfred H. Allen.
G. E. Scott-Smith.

Dudley, Charles Benjamin,
Drawer 334, Attoona, Penn., U.S.A.

Chemist, Pennsylvania Railroad Company. Ph.D. from Sheffield Scientific School of Yale College, 1874. Instructor Univ. of Penn., 1875. Chemist Penna., R.R.Co., 1875 to date. Published investigations on the Chemistry and Wear of Steel Rails, 1878—82. Also a series of articles on "Chemistry applied to Railroads," in 1889—1897. Many isolated papers on various Metallurgical and Chemical subjects. Prest. Am. Chemical Society, 1896 and 1897.

Charles F. Chandler. S. A. Goldschmidt.
H. T. Vulté. *Jas. S. C. Wells.*
Arthur H. Elliott. *Elwyn Waller.*

Fleming, John Arnold,
Britannia Pottery, Glasgow.

Potter. Practical Manager of a Pottery. Studied Analytical Chemistry under Dr. Readman, Edinburgh. Attended Dr. Stevenson Macadam's Lectures in Edinburgh, taking the First Class Medal of the year, and have continuously made chemical investigations in connection with my work.

Stevenson Macadam. *John Clark.*
G. H. Gemmell. *A. Humboldt Sexton.*
R. R. Tatlock. *G. G. Henderson.*
Edw. C. C. Stanford.

Garside, Arthur Leonard Harry,

C/o Messrs. Lawes and Co., Ltd., Barking Creek, Essex.

Analytical Chemist. Formerly Student in Chemistry, Physics, &c., at the Vivian Institute, Torquay, under C. W. Priestley, Esq., B.Sc., A.R.C.S. (Lond.) and at other Institutions. From 1895—97 Demonstrator in Chemistry, &c., at the Science and Art Schools of Torquay and Paignton. Since March, 1897, Assistant Chemist to the Lawes' Chemical Manure Co., Ltd., and Lawes' Chemical Co., Ltd.

Otto C. J. G. L. Overbeck.	C. W. Priestley.
Vincent Edwards.	J. Theo. Hewitt.
Walter D. Severn.	Frank Dixon.

F. Napier Sutton.

Gidden, William Thomas,

108, Vicarage Road, Langley, Birmingham.

Chemist to the British Cyanides Company, Oldbury. Five years Student of Chemistry at Central Technical College; Diploma of Associate of City Guilds Institute in Department of Chemistry. Assistant Demonstrator in Chemistry, East London Technical College, Session 1896—1897. Now Chemist to British Cyanides Company.

Henry E. Armstrong.	Gerald T. Moody.
William H. Davis.	Sidney Williamson.
James C. Philip.	William J. Pope.

Guthrie, Alexander, B.Sc.,

Bocking, Braintree, Essex.

Manager of Saml. Courtauld & Co.'s (Ltd.) Crape-finishing Works. For over four years studied Chemistry practically in Glasgow and Leipzic. For two years Chemist and Sub-Manager in Fish-Products Factory. Over two years Sub-Manager in Chemical Manufacturing Works. For two years Manager of White-Lead Works. Four years in charge of Silk Dyeing and Finishing.

John Ferguson.	James J. Dobbie.
G. G. Henderson.	C. M. Aikman.

Edmund J. Mills.

Heaton, John,

81, Garmoyle Road, Liverpool.

Brewer and Brewers' Chemist. Two years and a half Student of Chemistry under Mr. P. J. Beveridge, M.A., B.Sc., Laboratories Cowley Schools. A course of lectures on Organic Chemistry and Physics Owens College. Honours Technical Brewing, May, 1897, City Guilds Institute.

John Heron.	Arthur R. Ling.
Walter J. Sykes.	*Prosper H. Marsden.*
Leonard Temple Thorne.	*Chas. E. Eastick.*

Bernard Dyer.

Hislop, Lawrence,

Gas Works, Uddingston.

Engineer and Manager to Bothwell and Uddingston Gas Company, Ltd. Received my training in Chemistry (both Inorganic and Organic) in Glasgow and West of Scotland Technical College under T. A. Cheetham, Esq., F.C.S.; then for a short time in Messrs. Tatlock's Laboratory, Glasgow. For last five years (in present situation) have been engaged in Analytical work, such as Coal Analysis, Gas Analysis, &c., &c.

Thos. A. Cheetham. Archd. R. Ormiston.
James Knight. J. Watson Napier.

William E. Kay.

Hodgson, Harry Pearson,

Caldew Bank, Cummersdale, Carlisle.

Works Chemist. Completed a three years' course of Chemistry at Owens College. Assisted Professor Perkin and Dr. Thorpe in their work on *i*-Camphoronic Acid. In Leopold Cassella's Dye Works at Frankfurt-a-M.

Harold B. Dixon. D. Lawrence.
W. H. Perkin, jun. G. H. Bailey.

A. William Gilbody.

Hyland, John Shearson, Ph.D., M.A., F.G.S.

11, Powis Square, Bayswater, London, W.

Mining Engineer and Metallurgist. Studied Chemistry at the University of Leipzig, taking his degree in Chemistry, Physics, and Mineralogy. Author of original investigations on the Chemical Constitution of Minerals, *vide* Tschermak's *Mittheil*, 10, 88, and Scientific Proceedings of the Royal Dublin Society, 6.

W. N. Hartley. Edward Davies.
Henry A. Miers. Lazarus Fletcher.

William Crookes.

Jee, Edwin Charles,

45, Pepys Road, New Cross, S.E.

Engaged in Chemical Research at the Central Technical College. B.Sc. (London). Late Assistant Master and Science Teacher at Ormskirk Grammar School, South Lancashire.

Chas. E. Browne. Henry E. Armstrong.
Gerald T. Moody. William J. Pope.
Sidney Williamson Arthur Lapworth.

W. Palmer Wynne.

Jessop, Samuel Morton,

12, Hanson Terrace, Wakefield.

Laboratory Assistant, County Council Laboratory, County Hall, Wakefield. Engaged during past five years on the systematic investigations instituted by the West Riding of Yorkshire County Council into (*a*) Purification of Rivers, and (*b*) Plumbo-solvent Action of Moorland Water Supplies. Holds eight Certificates for the Science and Art Department's Examinations in Chemistry, including First Class Honours.

E. Frankland.	B. A. Burrell.
Alfred H. Allen.	*Thomas Fairley.*
Edward M. Chaplin.	*Frank Clowes.*

Jones, Edward,

Vine Cottage, Tudor Road, Kingston-on-Thames.

Analyst. Bachelor of Science, London University. Fellow of the Institute of Chemistry. For sixteen years Analyst in the Government Laboratory, London.

T. E. Thorpe.	C. Proctor.
R. Bannister.	J. Woodward.
H. J. Helm.	E. Grant Hooper.

Jones, William,

29, High Street, Wavertree, Liverpool.

Chemist and Dentist. Pharmaceutical 1874, Dental 1878. I desire admission to Chemical Society in order to read the publications of the Society, and so keep in touch with the latest discoveries of Chemical Science.

Arthur W. Warrington.	John W. Towers.
Jos. F. Burnett.	*James Grant.*
Herbert W. Seely.	*F. C. Hartmann.*

John Hargreaves.

Lowry, Thomas Martin,

28, St. Lawrence Road, W. Kensington, W.

Assistant in the Chemical Department of the Central Technical College, London, S.W. Diploma of the City and Guilds of London Institute, London University, B.Sc., with First Class Honours in Chemistry and Second Class Honours in Physics. Work on Chlorbromcamphor and on Nitrocamphor (*Proc.*, 1897, 13, 159).

Henry E. Armstrong.	W. J. Pope.
Gerald T. Moody.	Sidney Williamson.

F. Stanley Kipping.

Masson, George Henry,

22, Lauriston Place, Edinburgh.

Doctor of Medicine, Master of Surgery, Edinburgh; Bachelor of Science in the Department of Public Health, Edinburgh. Late Government Analyst under Food and Drugs Act, and Assistant to the Government Analyst, Port of Spain, Trinidad, B.W.I. Late Student Public Health Laboratory, Edinburgh University. Senior Medallist, Class of Practical Chemistry, Edinburgh University, Session 1891—1892.

Alex. Crum Brown.	Leonard Dobbin.
John Hunter.	*John S. Ford.*
Hugh Marshall.	*G. H. Gemmell.*

Mitchell, Albert Henry,

Martin's Lane, Tiverton, Devon.

Science Master. Have been engaged in teaching Chemistry since 1890, and for the last three years as Chemistry Master at the Tiverton Technical School. B.Sc. (London) and Honours South Kensington Organic and Inorganic Chemistry. Author of *Quantitative Exercises for Beginners*, Parts I. and II. Student at the Owens College (Evening Classes) 1891 and 1892.

Arthur Harden.	F. Gossling.
G. H. Bailey.	Geo. Stubbs.
J. Woodward.	*H. B. Dixon.*

Parker, Alfred James,

21, East Hill, Dartford, Kent.

Analytical Chemist. Three years' training Finsbury Technical College, 1st Prizeman in Inorganic and Analytical Chemistry and Organic Chemistry. Honoursman in Practical Inorganic Chemistry, South Kensington. Six years Messrs. Burroughs, Wellcome and Co., Manufacturing Chemists, Dartford, Kent, Analytical Laboratory, and Chemist to the Physiological Department. One and a-half years Messrs. Parke, Davis and Co., Manufacturing Chemists, North Audley Street, W., and Detroit, U.S.A., Consulting Chemist and Superintendent of Laboratory.

J. H. Robbins.	*R. Bannister.*
R. Meldola.	*H. J. Helm.*
F. Harwood Lescher.	*J. Woodward.*

Paters, Walter Charles Cross,

14, Trinity Square, S.E.

Demonstrator of Public Health at Guy's Hospital.

Thos. Stevenson.	John Wade.
Charles E. Groves.	Arthur R. Ling.

William J. Pope.

Ratcliffe, Walter,

21, Mawdsley Street, Bolton.

Analytical and Consulting Chemist, Assayer, &c. Chemist to the Bolton Corporation. Late Chemist to the Dominion Cotton Mills Co., Montreal.

George J. Allen. — Charles A. Fogg.
William B. Mason. — Harold Rostron.

Jno. L. Whiteside.

Smith, Francis Pitt,

77, Woodland Avenue, New Rochelle, N.Y., U.S.A.

Bachelor of Philosophy in the course of Analytical and Applied Chemistry, School of Mines, Columbia University, 1888. Tutor in Chemistry, Columbia University, 1897—98. Analyst, New York City Board of Health, 1890—91. Chemist, U.S. Navy Department, 1892—95. Papers: Editor, *Anthony's Photographic Bulletin*, 1893, "Paint as a Protection for Iron," the Engineers' Club of Philadelphia. Nov. 16th, 1895.

Charles F. Chandler. — Arthur H. Elliott.
Jas. S. C. Wells. — Hermann T. Vulté.
Elwyn Waller. — *S. A. Goldschmidt.*

Smith, Thomas De,

Eastbourne College, Eastbourne.

Natural Science Master. B.A., late Scholar of Jesus College, Cambridge. 1st Class Natural Science Tripos. 1st and 2nd M.B. Examinations, including Pharmaceutical Chemistry. Natural Science and Mathematical Master, Eastbourne College.

M. M. Pattison Muir. — G. S. Turpin.
S. Ruhemann. — R. S. Morrell.
Charles T. Heycock. — J. E. S. Tuckett.

Somerville, Henry,

33, Vincent Square, S.W.

Lecturer on Chemical Physics at Westminster Hospital Medical School. Senior Lecturer on Chemistry United Westminster School. B.Sc. (London)—[Chemistry and Physics].

A. Dupré. — Jervis E. Foakes.
C. F. Cross. — Edward Bevan.

H. Wilson Hake.

Spivey, William Thomas Newton,

5, Trumpington Street, Cambridge.

M.A. Trinity College, Cambridge. Demonstrator to the Jacksonian Professor of Natural Philosophy, Cambridge.

James Dewar. W. J. Sell.
G. D. Liveing. H. J. H. Fenton.
Thomas H. Easterfield.

St. John, Harry,

Thornfield, Sunderland.

Wine and Spirit Merchant, Brewer and Analytical Chemist. Two years' Certificate of attendance at Durham College of Science in Chemistry, Physics, and Mathematics. Two years' pupilage at two Breweries in Practical Brewing. Two years' pupilage in Analytical Chemistry applied to Brewing. Two years' pupilage in Analytical Chemistry under London Analyst. Certificates from South Kensington in Organic and Inorganic Analysis, Advanced. Member of the Society of Chemical Industry. General Manager, Head Brewer, and Analyst to firm of William St. John for past six years.

W. Dixon. *W. H. Blake.*
C. Ranken. *H. O. Hale.*
William Fowler. *Chas. Wm. Sutton.*

Walker, Samuel,

126, Gilmore Place, Edinburgh.

M.A., B.Sc., Edin. Teacher of Chemistry in George Heriot's Hospital School, Edinburgh. For seven years Teacher in Perth Academy, and in Sharp's Institute, Perth, and Lecturer to Science and Art Classes in Chemistry, &c. For twelve years Chemistry Master in Heriot's School, Edinburgh. Assisted the late Prof. Carnelly in his investigations on some Derivatives of Diphenyl.

Alex. Crum Brown. Leonard Dobbin.
Andrew Thomson. J. Gibson.
W. H. Perkin, jun. *Hugh Marshall.*

Williamson, John Alexander,

81, Cheverton Road, Upper Holloway, N.

Analytical Chemist. Student at Glasgow University two years under Prof. J. Ferguson, M.A., and Prof. G. G. Henderson, M.A., D.Sc., F.I.C.; five years under R. R. Tatlock, F.R.S.E., F.I.C., F.C.S., Glasgow; one year as Chemist in Askam-in-Furness Iron Works, Lancashire; two and a half years Laboratory Chemist, and Chemist in charge of manufacture to the British Explosives Synd., Pitsea, Essex.

At present Analyst to Messrs. Baird and Tatlock, London. Publication in *J.S.C.I.* 1894, p. 1098.

R. R. Tatlock. John Ferguson.
G. G. Henderson. Wm. Rintoul.
W. R. Lang. Horatio Ballantyne.
W. Mackean.

Wood, Thomas Barlow,
Caius College, Cambridge.

Lecturer on Agricultural Chemistry. M.A. Caius College, Cambridge.

James Dewar. W. J. Sell.
G. D. Liveing. H. J. H. Fenton.
Thomas H. Easterfield.

Woodhead, Samuel Allinson,
Agricultural College, Uckfield, Sussex.

Science Lecturer and Analyst for the County of East Sussex. Lecturer in Chemistry (General and Agricultural) at the Agricultural College, Uckfield. Science Master at the Uckfield Grammar School. Bachelor of Science (Durham). Prizeman in Practical Chemistry. Public Analyst for the County of East Sussex and Town of Hove. Author of paper on Agricultural Chemistry.

P. Phillips Bedson. F. C. Garrett.
Saville Shaw. E. H. Farr.
R. Greig Smith. *John M. Thomson.*

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY

Issued 7/4/1898

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 192. Session 1897–8.

March 31st, 1898. Aniversary Meeting. Professor Dewar, F.R.S., President, in the Chair.

Mr. W. G. McMillan and Dr. Thorne were appointed Scrutators, and a ballot was opened for the election of Officers and Council for the ensuing year, the ballot being closed at the conclusion of the President's address.

The President, in beginning his address, remarked that the papers submitted to the Society during the past session included original work in all branches of Chemical Science. They have been contributed, not only from the laboratories of the older Universities of Oxford and Cambridge, but also from the University Colleges and other institutions throughout the country. The publications of the Society are, therefore, a complete record of English Chemical Science, and of the researches pursued at different educational centres throughout the country.

The *Proceedings* is now the medium of publication, not only of abstracts of papers which will subsequently appear in the *Transactions*, but also of the rapid publication of short papers and preliminary notices.

The rule, which came into force last year, requiring that authors shall deposit their papers and abstracts with the Secretaries before they are officially announced for reading at a meeting, has worked well; it has made it possible to expedite the publication of the *Proceedings*, and to send advance proofs to the authors for correction.

The meetings have been well attended, the meeting-room being often quite full. Occasionally, interesting discussions have taken place, but as so many of our papers deal with details and matters of fact, anything like a debate must necessarily be of rare occurrence.

The following past Presidents, Lord Playfair, Dr. A. W. Williamson, Sir E. Frankland, Dr. W. Odling, Sir F. A. Abel, Dr. J. H. Gladstone, Sir J. H. Gilbert, this year complete a connection of 50 years with the Society. To mark its sense of the great services they have rendered to Chemical Science, the Council has resolved to entertain them, in the name of the Society, at a dinner on June 9th, given to commemorate their half-century of Fellowship of the Society.

During the past year the Council has had under consideration the question of a revision of the Bye-laws. A Committee was appointed early in the year, which has met several times during the session, but, in view of the wider questions which have occupied the attention of the Council, they have not been able to complete their report.

During the session a section of the Fellows residing at a distance from London have expressed a desire to take part in the election of Officers and Council, without being forced to undertake a journey to London to register their votes at the Annual General Meeting. A Memorial was drawn up, asking the Council to prepare and lay before the Society a Bye-law enabling Fellows to record their votes by post. This Memorial was signed by 540 Fellows, of whom 400 resided outside the London district. In the meantime, the Bye-law Committee had taken steps to ascertain the powers of the Society in this matter under their Charter. They were legally advised that any Bye-law framed to admit voting by post or proxy would be repugnant to the Charter, and therefore invalid.

When the Memorial was presented to the Council, a covering letter contained another suggestion, viz., that it might probably be necessary to obtain a Supplemental Charter, in order to enable the Council to carry out the wishes of the Memorialists. This suggestion was seriously considered by the Council, and further legal opinion was taken on the subject. They were advised that no application for a Supplemental Charter which was not supported by the practically unanimous wish of the Fellows would be listened to by the Privy Council. They have since been further advised that it would be *ultra vires* on their part to expend any part of the funds of the Society in applying for a Supplemental Charter. All the documents relating to the Memorial and the various legal opinions, together with the decisions of the Council, have already appeared in the *Proceedings*, pp. 1, 33, 61 (this volume).

The following eminent foreign chemists, whose names are familiar to us all as of those who have advanced knowledge in various departments of our science, were elected Foreign Members in January of this year, bringing the total number of Foreign Members of the Society up to 38: Professors S. Arrhenius; Th. Curtius; A. P. N. Franchimont; W. Körner; W. Markownikoff; N. A. Menschutkin; H. Moissan; W. Ostwald; F. M. Raoult; I. Remsen; W. Spring; L. J.

Troost; P. Waage; J. D. van der Waals. The Society has lost a Foreign Member by death: Professor Victor Meyer, one of the most brilliant and original of the modern school of chemists. The Kekulé Memorial Lecture has been delivered by Professor Japp. It has been resolved that the Memorial Lectures delivered up to 1896 shall be bound and published as Vol. I. of the Society's Memorial Lectures as soon as possible.

The Council have nominated the Treasurer and Editor as delegates for the Society to the National Committee appointed by the Royal Society to prepare a Catalogue of Scientific Literature.

The remainder of the President's address was devoted to an account of recent advances in Low Temperature Research, which will subsequently appear in the *Transactions*.

The numerical strength of the Society was as follows:—

Number of Fellows, March 31st, 1897		2079
,, ,, since elected		114
,, ,, reinstated by Council		4
		2197
Removed on account of non-payment of two annual subscriptions	17	
Withdrawn	22	
Deaths	18	
		57
Number of Fellows, March 31st, 1898		2140
Foreign Members		38

Fourteen Foreign Members were elected during the year.

The names of those removed were:—J. Burgess; T. R. Carswell; L. B. Dutson; W. T. Gibbs; R. B. Greaves; T. B. Hall; E. H. Hill; P. Hudson; C. W. Lee; D. C. Mackenzie; W. M. Martin; R. A. Rouillard; J. W. Slater; J. W. Smith; R. M. Sumner; W. Virtue; W. H. Walden.

The following have withdrawn:—C. L. Barnes; J. C. Cain; W. Johnstoun Coombes; E. C. Copas; J. H. Freeman; D. St. J. Grant; A. L. Guiterman; James Hall; John Howard; R. E. Hughes; J. W. James; A. Luty; A. Kinninmont; D. J. Morgan; E. W. Napper; E. W. Prevost; Frederick Quincke; D. H. Richards; A. E. Richardson; R. Routledge; W. E. Sim; E. E. H. Thorne; C. A. Warren.

The following have died:—J. J. Bowrey; G. W. Child; E. H. Gaskell; B. H. Gibbins; W. A. L. Hammersley; S. J. Harris; Walter Jardine; G. A. Keyworth; M. H. Lackersteen; Samuel Lees; Herman Lescher; Thomas Mitchell; Howard Newton; F. M. Rimmington; J. W. Rodger; Taraprasanna Roy; W. J. Saint; James Napier.

The number of communications made to the Society during the year was 127.

One hundred and fourteen papers were published in the *Transactions* for 1897, occupying 1204 pages, whereas in the preceding year 117 papers were published, occupying 1702 pages.

The following were the statistics relating to the Abstracts.

	Pages.	No. of Abstracts.
Part I.		
Organic Chemistry	648	1049
Part II.		
General and Physical Chemistry		324
Inorganic Chemistry		270
Mineralogical Chemistry		192
Physiological Chemistry		168
Chemistry of Vegetable Physiology and Agriculture		158
Analytical Chemistry		414
Total in Parts I. and II.	612	1526
	1260	2575

Eight hundred and fifty volumes had been borrowed from the Library. The additions comprised 78 books, 282 volumes of periodicals, and 36 pamphlets.

Sir W. Crookes, F.R.S., proposed a vote of thanks to the President, coupled with the request that he would allow his address to be printed in the *Transactions*.

Dr. W. J. Russell, F.R.S., seconded the motion, which was carried by acclamation.

The President having returned thanks,

Dr. Thorpe, F.R.S., the treasurer, gave an account of the balance sheet, which he laid before the Society, duly audited.

The receipts had been:—By admission fees and subscriptions, £3827; by sale of Journal and advertisements, £686 3*s.* 6*d.*; and by dividends on invested capital, £414 6*s.* 0*d.* The expenses had been:—On account of the Journal, £2963 11*s.* 1*d.*; on account of the Proceedings, £278 7*s.* 10*d.*; on account of the General Index, £182 18*s.* 1*d.*; on account of the Library, £307 4*s.* 9*d.*; House expenses, £203 6*s.* 7*d.*; the total expenditure being £4807 6*s.* 8*d.* Grants amounting to £150 had been made to Fellows from the Research Fund during the year.

Dr. Gladstone, F.R.S., proposed that the thanks of the Fellows be

tendered to the Treasurer for his services during the past year; this motion was seconded by Dr. STEVENSON, and carried.

The TREASURER, in responding, proposed a vote of thanks to the auditors.

Dr. ATKINSON seconded the motion, which was unanimously adopted, and acknowledged by Mr. R. J. FRISWELL.

Mr. D. HOWARD proposed a vote of thanks to the Officers and Council.

Mr. CASSAL seconded the motion, which was unanimously adopted.

Prof. THOMSON, F.R.S., responded on behalf of the Council.

Dr. B. DYER proposed a vote of thanks to the Editor, Sub-Editor, Abstractors, and Indexers, which was seconded by Mr. R. J. FRISWELL, and carried.

Mr. GROVES, F.R.S., responded.

The Scrutators having presented their report to the President, he declared that the following had been duly elected :—

President: James Dewar, M.A., LL.D., F.R.S.

Vice-Presidents who have filled the office of President: Sir F. A. Abel, Bart., K.C.B., D.C.L., F.R.S.; H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir W. Crookes, F.R.S.; Sir E. Frankland, K.C.B., D.C.L., F.R.S.; Sir J. H. Gilbert, Ph.D., LL.D., F.R.S.; J. H. Gladstone, Ph.D., D.Sc., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.B., F.R.S.; W. H. Perkin, LL.D., Ph.D., F.R.S.; Lord Playfair, G.C.B., LL.D., F.R.S.; Sir H. E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents: F. R. Japp, M.A., LL.D., F.R.S.; G. D. Liveing, M.A., D.Sc., F.R.S.; William Ramsay, Ph.D., LL.D., F.R.S.; J. Emerson Reynolds, M.D., D.Sc., F.R.S.; John M. Thomson, F.R.S.; William A. Tilden, D.Sc. F.R.S.;

Secretaries: Wyndham R. Dunstan, M.A., F.R.S.; W. P. Wynne, D.Sc., F.R.S.

Foreign Secretary: Raphael Meldola, F.R.S.

Treasurer: T. E. Thorpe, LL.D., F.R.S.

Other Members of Council: P. Phillips Bedson, D.Sc.; E. J. Bevan; H. J. H. Fenton, M.A.; W. Gowland; Otto Hehner; C. T. Heycock, M.A., F.R.S.; D. Howard; Herbert McLeod, F.R.S.; Rudolph Messel, Ph.D.; H. Forster Morley, M.A., D.Sc.; Alexander Scott, M.A. D.Sc.; Arthur Smithells, B.Sc.

At the next meeting, on Thursday, April 21, there will be a ballot for the election of Fellows, and the following papers will be communicated. The authors of those marked * have expressed their intention of being present.

*"The carbohydrates of barley straw." By C. F. Cross, E. J. Bevan, and Claud Smith.

*"Isomeric bornylamines." By M. O. Forster, Ph.D.

*"Some derivatives of benzophenone." By F. E. Matthews, Ph.D.

"Researches on camphoric acid." By S. B. Schryver, Ph.D.

"The yellow colouring matters of some plants containing tannin. Part V." By A. G. Perkin and P. J. Wood.

"The yellow colouring matters of the leaves of *Arctostaphylos uva ursi*." By A. G. Perkin.

LIST OF FELLOWS.

A new list of Officers and Fellows of the Chemical Society being in course of preparation, it is requested that Fellows will send any alteration of address, without delay, to the Assistant Secretary, Burlington House, London, W.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY

Issued 28/4/1898

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 193. Session 1897–8.

April 21st, 1898. Professor Dewar, F.R.S., President, in the Chair.

Messrs. H. C. Seabrooke, W. W. Cheadle, T. H. Hills, and B. S. Bull, were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Edwin Dowzard, 30, The Willows, Liverpool; Alexander Grant Russell Foulerton, Dunsdale, Mulgrave Road, Sutton; Oswald Hamilton, Old Stratford, Stony Stratford; George Arthur Jarvis, 66, Millbank, Wellington, Salop; Harry Lar[illegible] Lee, 8, Chichester Street, St. George's Square, S.W.; William Lewins, 43, Exeter Street, Gateshead; Alexander MacGillivray Neilson, Coimbatore, Madras; Henry Trench Waller, Zeehan, Tasmania; Edmund Thomas Whitaker, Swan Hill Court, Shrewsbury; William Ernest Wild, 230, Turton Road, Bromley Cross, near Bolton.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected Fellows of the Society.

Henry William Coupe-Annable; Albert Abbott, B.A.; Charles Baskerville, B.S., Ph.D.; Joseph Brierley, B.Sc.; Alfred Campion; Robert Martin Caven, B.Sc.; Frederick Hudson-Cox; Charles Benjamin Dudley, Ph.D.; John Arnold Fleming; Arthur L. Harry Garside, B.Sc.; William Thomas Gidden; Alexander Guthrie, B.Sc.; John Heaton; Lawrence Hislop; Harry Pearson Hodgson; J. Shearson Hyland, Ph.D., M.A.; Edwin Charles Jee, B.Sc.; Samuel Morton Jessop; Edward Jones, B.Sc.; Thomas Martin Lowry, B.Sc.; George Henry Masson, B.Sc.; Albert Henry Mitchell, B.Sc.; Alfred James Parker; Walter Charles Cross Pakes; Walter Ratcliffe; Francis Pitt Smith; Thomas de Smith, B.A.; Henry Somerville, B.Sc.; William T.

Newton Spivey, M.A.; Harry St. John; Samuel Walker, M.A., B.Sc.; John Alexander Williamson; Thomas Barlow Wood, M.A.; Samuel Allinson Woodhead, B.Sc.

Of the following papers those marked * were read :—

***49. "The carbohydrates of barley straw." By C. F. Cross, E. J. Bevan, and Claud Smith.**

The authors have continued their investigations of growing barley, extending their observations to the plant under the artificial conditions induced by the removal of the ears at the flowering stage. The diversion of the energies of the plant from its normal seed-bearing function proved to be without influence upon the proportion of furfural-yielding carbohydrates to total carbohydrates. The constancy of this ratio has now been established under the widest possible variations of the conditions of growth, natural and artificial, confirming the conclusions that the furfuroids are assimilated with their special constitutional characters and not formed from hexoses by subsequent processes of oxidation.

By the suppression of the seminal function of the plant, the 'maturation' of the straw was virtually arrested, and this is shown by the chemical constants determined in the straw grown up to the harvesting period after removal of the ear, compared with the straw grown under normal conditions. The cellulose and "permanent tissue" are 30 and 10 per cent. respectively in excess in the normal straw, and conversely the artificial product is much more readily hydrolysed by acids, and the resulting solutions (after neutralisation) are fermented by yeast to a much greater extent.

Discussion.

Dr. Voelcker, speaking from the practical and agricultural rather than from the theoretical side, enquired what was the influence of these different constituents—pentoses, hexoses, and the like—in determining the value of cereal straws at the various stages of growth. The feeding value of straw depends on the period of cutting, but the constituents determining this value were not known.

The results of the plan adopted of cutting off the ears and thus preventing formation of grain had some analogy with those obtained in keeping a clover crop closely cut down. There was an increase of root growth and a consequent enrichment of the soil by accumulation of nitrogen. It was of interest, therefore, to know what happened in the case of cereal straws similarly treated, and in what respects enrichment took place. If the enquiry could be followed up by actual

feeding experiments, some knowledge of the utility of those different complex substances at which the authors were working would be attained.

Dr. HORACE BROWN said that in the case of barley plants which had been deprived of their fructifying organs the increased percentage of permanent tissue and of cellulose was probably due to the accumulation in the straw of the products of assimilation which under natural conditions would have been utilised by the seed. He also expressed a hope that the authors would soon be in a position to give more definite information about the nature of the fermentable carbohydrates which are produced by the acid hydrolysis of these interesting furfuroids.

Mr. CROSS, in reply, said that he hoped to give effect to some of the suggestions in a repetition of the experiments on a more extended scale during the current season.

***50. "Isomeric bornylamines." By M. O. Forster, Ph.D.**

It has been observed by Leuckart and Bach (*Ber.*, 1887, 20, 104) that when camphor is heated with ammonium formate at 200°, it is converted into the formyl derivative of bornylamine; the base from this derivative melted at 159—160°, and had the specific rotatory power $[\alpha]_D = -18{\cdot}6°$. By the reduction of camphoroxime with sodium and amylic alcohol, the author has obtained two bases having the empirical formula $C_{10}H_{19}N$; one of these substances melts at 163°, and has the specific rotatory power $[\alpha]_D = +45{\cdot}5°$, whilst the other melts at 180°, and has $[\alpha]_D = -31{\cdot}3°$. Having found that the base prepared by the method of Leuckart and Bach is a mixture of these two compounds, the author proposes to retain the name *bornylamine* for the dextro-rotatory base, and as the compounds are not optical antipodes, to term the isomeride *neobornylamine*.

The *formyl*, *acetyl*, and *benzoyl* derivatives, and the *hydrochloride*, *platinichloride*, *carbamide*, *phenylcarbamide*, and *picrate* of both bases have been prepared, and are described in the paper.

***51. "Some derivatives of benzophenone." By Francis Edward Matthews, Ph.D.**

Benzophenone in a moist chloroform solution very readily yields a hexachloride, $C_6H_5Cl_6{\cdot}COPh$, on saturation with chlorine and exposure to bright light.

Only one modification of this substance appears to be produced in this manner, and all attempts to introduce a further six atoms of chlorine into the molecule proved fruitless. No hexachloride could be

obtained from acetophenone. Benzophenone hexachloride crystallises from xylene in brilliant colourless forms melting at 215°. It is a very stable substance, but on heating at a temperature considerably above its melting point, evolves hydrogen chloride and benzoyl chloride, and yields a heavy yellow oil from which trichlorobenzophenone was isolated in the crystalline state.

On decomposition with alcoholic soda, benzophenone hexachloride is decomposed in two directions. One interaction results in the elimination of hydrogen chloride and production of the trichlorobenzophenone, which crystallises from acetone on spontaneous evaporation in large hexagonal prisms or plates, and melts sharply at 131°. The second decomposition is represented by the equation: $C_6H_5Cl_6 \cdot CO \cdot C_6H_5 + NaOH = C_6H_6Cl_6 + C_6H_5 \cdot CO_2Na$, and the resulting benzene hexachloride is decomposed, producing 1 : 2 : 4 trichlorobenzene. The benzoic acid produced in the hydrolysis was identified.

Benzophenonehexa chloride on nitration yields a mono-nitro-derivative of the formula $C_6H_5Cl_6 \cdot CO \cdot C_6H_4(NO_2)$, which crystallises in pale yellow needles and melts at 159°. This compound is decomposed by alcoholic soda in the same way as the parent substance. The products are 1 : 2 : 4 trichlorobenzene, metanitrobenzoic acid, a small quantity of an azo-compound and metanitrotrichlorobenzophenone. The last substance forms pale yellow hexagonal plates from acetone and melts at 143°.

Benzophenone hexachloride dissolves in hot fuming sulphuric acid, producing a sulphonic acid. From this acid the barium salt was prepared; it crystallises in tufts of needles and contains $7\frac{1}{2}$ molecular proportions of water. It is readily decomposed by alkalis, but as the products do not crystallise well they have not been further examined.

***52 "Experiments on lauronolic acid." By S. B. Schryver, Ph.D.**

An attempt was made to prepare an unsaturated isomeride from the ethylic salt of camphanic acid (oxycamphoric acid) in the same way that teraconic acid is obtained from terebic acid (Roser, *Ann.*, 1883, 220, 255). Ethylic camphanate is, however, unacted upon by sodium ethoxide, the reagent used by Roser to bring about the above-mentioned reaction. Lauronolic acid was then investigated, and a method is described for its preparation on a large scale. It was oxidised with potassium permanganate, but no definite products were obtained, the acid appearing to be totally oxidised, the potassium permanganate acting on it in the same way as on the tetrahydrophthalic acids investigated by v. Baeyer. For this reason, it was thought that lauronolic acid was a hydrogenised benzene derivative. Nitric acid acts on lauronolic acid violently, yielding principally oxalic acid. In

addition, however, it forms *nitrocampholactone*, a neutral product of the formula $C_9H_{13}O_2(NO_2)$, and under certain conditions this substance can be obtained in fairly large quantity. It melts at 171°, is insoluble in water, but soluble in most organic reagents. On reduction with zinc dust and glacial acetic acid, it yields the corresponding *hydroxylaminocampholactone*, $C_9H_{13}O_2(NHOH)$, which melts at 148°, reduces Fehling's solution and ammoniacal silver nitrate in the cold, and is soluble in hot water, from which it separates on cooling in the form of twinned, quadratic prisms. The hydroxylamine derivative, on oxidation with ferric chloride, yields *nitrosocampholactone*, $C_9H_{13}O_2(NO)$, a bright-green compound melting at 117°, and very soluble in most organic solvents. Nitrocampholactone, on reduction with tin and hydrochloric acid, yields *aminocampholactone*, $C_9H_{13}O_2(NH_2)$, a compound readily soluble in water, from which it crystallises in large, pearly plates containing water, which melt at 39°, but effloresce in a vacuum, giving an anhydrous substance melting at 66°. The platinichloride decomposes without fusion above 200°, and is a salt, not of the aminolactone itself, but of the corresponding aminohydroxy-acid, $[C_9H_{15}O_3(NH_2)HCl]_2PtCl_4$. The nitroso-compound can also be obtained by the action of nitrogen peroxide on lauronolic acid, but was not isolated, as the further action of the peroxide converts it into the nitro-compound, which, indeed, can be more conveniently prepared in this way, as the yield is greater than that obtained by the action of nitric acid. Campholactone also gives a certain amount of nitrocampholactone on treatment with nitric acid.

The hydrochloride of aminocampholactone, on treatment with potassium nitrite, yields *hydroxycampholactone*, m. p. 118°, and a liquid of sweet peppermint-like smell.

If Piloty's recent generalisation (*Ber.*, 1898, 31, 219), that stable nitroso-derivatives can only be derived from hydroxylamines in which the NHOH group is attached to a tertiary carbon atom, be applicable to cylic compounds, then neither the Bredt nor the Perkin formula can correctly represent the constitution of camphoric acid.

*53. "The drying of ammonia and of hydrogen chloride." By H. Brereton Baker, M.A.

In a recent paper (*Ann.*, 1898, 299, 267), Gutmann has described experiments on the action of these gases when dried. He comes to the conclusion that the drying of both gases by phosphorus pentoxide is an impossibility, because they are absorbed by the drying agent in a shorter time than is necessary to dry them. The author has repeated the experiments, and finds that this absorption of the gases, when properly purified and dried by lime and sulphuric acid respectively,

only takes place when the phosphorus pentoxide is impure. When the oxide contains any quantity of metaphosphoric acid, the absorption takes place as rapidly as, and with similar results to, those described by Gutmann. From the construction of the apparatus, as well as from the similarity of the results, it is concluded that moisture was admitted while the phosphorus pentoxide was present, and that the difference between his results and those of the author published in 1894 is readily explained as due to the production of metaphosphoric acid.

With regard to the vapour density of ammonium chloride, it is pointed out that Gutmann's low results are probably due to his having collected the air, driven out of the Victor Meyer apparatus, over water and sulphuric acid instead of over boiled mercury, which was used by the author. A re-determination of the vapour density of dried ammonium chloride by Dumas' method is published in the paper. When the bulb was protected from the outer air by a phosphorus pentoxide tube terminated by a long capillary, the density of 28·8 was obtained from the dried ammonium chloride, confirming the author's conclusion, based on six experiments by Victor Meyer's method, that dried ammonium chloride does not dissociate at 350°.

Discussion.

Mr. Shenstone said he believed the precautions taken by Dr. Gutmann for preventing the access of water vapour to the dried ammonium chloride while determining its vapour density were insufficient, as Mr. Baker had shown; he had himself employed the very same precautions for a similar purpose in some of his earlier work on the production of ozone from oxygen, and though the results obtained were independently confirmed, and for some time accepted as correct, yet afterwards it became clear that the precautions in question had not really been sufficient for the purpose. Mr. Baker's explanation of the divergent results obtained by Dr. Gutmann and himself in their studies of the interactions of hydrochloric acid and ammonia, respectively, with phosphoric anhydride showed the importance of using pure phosphoric anhydride for such work, and he therefore ventured to draw attention to the fact that this substance cannot be prepared by merely redistilling the crude phosphoric anhydride. Certain precautions must be taken, *e.g.*, it is necessary to employ as low a temperature as is possible in order to avoid volatilising any metaphosphoric acid that may be present, and to seal up the product in glass tubes directly it is made.

The President said, in connection with Mr. Baker's results, it was interesting to remember that, in an elaborate paper in the *Phil. Trans.* for 1885, Professors Ramsay and Young detailed many

experiments proving that the statical and dynamical vapour pressures of ammonium chloride were identical, and that the vapour pressures found at about 330° compared with the vapour density of about 15 found by them, give a calculated latent heat which amounts to about 34650 gram units per molecule, or to about 80 per cent. of the theoretical value for complete dissociation. Mr. Baker obtained a normal vapour density at 350°, or about twice that of Ramsay and Young. Assuming the tensions of the vapour to be correct, and the density to be really double that found by Ramsay and Young, then the molecular latent heat would be reduced to about one-half of the value just mentioned. But can it be assumed that the tensions of the perfectly dry salt have been determined, or that they would be identical with the values already recorded? A series of such values with ammonium chloride completely free from water, together with vapour density determinations at lower pressures, would give most valuable results, and as the real interest of the research lay in this direction, he hoped the author would attack the problem.

***54. "Note on some of the properties of methylene di-iodide." By H. G. Madan, M.A.**

Methylene di-iodide, CH_2I_2, has for many years been used by mineralogists on account of its extremely high density (3·34 times that of water). This is, as usual, accompanied by a very high refractivity for light, which has been fully examined by Dr. Gladstone (*Trans.*, 1891, 59, 293), who found the index of refraction for yellow light (D) to be 1·756 at 10·5°, and the author has obtained nearly identical values with a different specimen. The coefficient of dispersion ($\mu_{H\gamma} - \mu_{H\alpha} = 0{\cdot}062$) is decidedly higher than that of carbon disulphide, and, but for its doubtful permanency in light, methylene di-iodide might advantageously replace the latter substance in spectroscope prisms, especially as its boiling point is very high (181°), and as it is practically non-inflammable. A few hours' exposure to strong sunlight turns it a light orange colour, and an exposure of 10 days deepens this to a red tint.

At a temperature of 100°, sulphur dissolves in methylene di-iodide fairly easily, but some crystallises out on cooling; enough, however, remains in solution at ordinary temperatures to raise the index for D to 1·778.

Methylene di-iodide dissolves phosphorus readily and abundantly; in fact, its own weight (or, taking into account the relative densities, about twice its volume) of phosphorus may be dissolved in it without reaching the point of saturation at ordinary temperatures. The resulting light yellow liquid has, as might be predicted, a very high refractivity, the index of refraction for the D line being 1·95 at 14°.

The third decimal place is not given, owing to a fact not readily explained, which was also noticed by Gladstone and Dale (*Phil. Mag.*, 1859, [iv], 18, 30) in dealing with solutions of phosphorus in carbon disulphide; viz., a difficulty in obtaining a sharp image of the spectrometer slit through the solution. The solution is, unfortunately, readily acted on by light, like similar solutions of phosphorus, a deposit of red phosphorus being formed.

This solution is far safer to deal with than the solution of phosphorus in carbon disulphide. A few drops poured on filter paper may be left freely exposed to the air for hours and even days without catching fire, the scarcely inflammable solvent seeming to form a kind of varnish over the phosphorus which protects the latter from rapid oxidation.

Discussion.

Mr. Vernon Harcourt suggested that the presence of phosphorus in the methylene di-iodide might serve the incidental purpose of preventing the coloration of the liquid when exposed to light.

The President asked if Mr. Madan had observed that the production of free iodine on exposure to light was in any way dependent on the presence of oxygen or traces of water. In the case of carbon disulphide, to which the author had referred as giving a deposit in prisms on exposure to light, this was certainly caused by a secondary action, which involved the presence of water, since perfectly dry carbon disulphide enclosed in sealed tubes, and exposed to sunlight, in presence of a dehydrating agent like sulphuric acid did not form any deposit.

Mr. Madan, in reply to Mr. Harcourt, said that he was afraid that the phosphorus did not seem to have the hoped-for result. In fact, the traces of iodine liberated appeared (as was noticed long ago by Sir B. C. Brodie, *Trans.*, 1853, 5, 289) to hasten the conversion of the phosphorus into the red allotropic form; and the solution, whether in a sealed tube or in an open watch-glass eventually solidified to an orange or red mass. In reply to the President, he said that the methylene di-iodide had been dried as far as possible by calcium chloride before being placed in the tubes for exposure to light, but he would take an early opportunity of ascertaining the result of a more careful and complete desiccation.

55. "The condensation of chloral hydrate with orcinol." By J. T. Hewitt, M.A., D.Sc., and F. Dixon, B.Sc.

The authors have reinvestigated the substance obtained by Michael and J. P. Ryder by the condensation of chloral hydrate and orcinol. The formula assigned to the substance by Michael and Ryder was

$C[C_6H_2(CH_3)(OH)_2]_3CH(OH)_2$. The authors find that on heating the aldehyde and phenol in aqueous solution at 100° for 16 hours a colourless product is obtained, which melts at 252—263°, and has the formula $C_{16}H_{16}O_6$. The molecular weight determined by raising the boiling point of an alcoholic solution was found to lie between 296 and 336. On heating in an atmosphere of coal gas, the acid loses a molecule of water and is converted into an almost colourless lactone having the formula $C_{16}H_{14}O_5$. A triacetyl-derivative of the lactone is formed by heating the acid with excess of acetic anhydride. This derivative is colourless and melts at 189°. On boiling the acid with excess of benzoyl chloride and pouring the hot solution into light petroleum, a tribenzoyl derivative of the lactone is obtained. The tribenzoate has the composition $C_{37}H_{26}O_8$, has no proper melting point, is apparently insoluble in water, alcohol, and light petroleum, and when allowed to remain in dilute alcohol for some time, is converted into a dibenzoate of the acid which melts at 204°, is readily soluble in alcohol, and has the formula $C_{30}H_{24}O_8$.

56. "Note on hexamethylene and its derivatives." By Emily C. Fortey, B.Sc.

In a preliminary note on hexanaphthene and its derivatives (*Proc.*, 1897, **13**, 161) it was stated that this hydrocarbon had been obtained from American light petroleum in a state of partial purity, and its identity with hexamethylene was pointed out. It has since been obtained by means of fractional distillation from Galician petroleum. The purest fraction boils almost constantly at 81·75°, and has a specific gravity of 0·7899 at 0°/0°. The following derivatives have been prepared. *Monochlorhexamethylene*, $C_6H_{11}Cl$, was obtained by passing a current of dry chlorine into the liquid for some hours. It is a colourless liquid boiling at 141·3—141·6° under a pressure of 768 mm., and has a specific gravity of 0·9991 at 0°/0°. *Dichlorhexamethylene*, $C_6H_{10}Cl_2$, was obtained together with mono- and a little tri-chlorhexamethylene by passing a rapid current of chlorine into heated hexamethylene. It is a colourless liquid when pure, but rapidly turns blue on exposure to air. It boils with slight decomposition at 194—195° under atmospheric pressure. Both mono- and di-chlorhexamethylene give a deep red coloration on warming with concentrated sulphuric acid. On heating dichlorhexamethylene with quinoline a small quantity of a substance boiling between 80° and 90° is obtained, which appears to be dihydrobenzene. Its alcoholic solution gives a blue coloration with sulphuric acid (Baeyer, *Ber.*, 1893, **26**, 230). Tetrahydrobenzene was obtained by heating monochlorhexamethylene with quinoline for 7 or 8 hours. It is a colourless liquid having the

properties described by Baeyer (*l. c.*), and boils at 82·3° under a pressure of 764 mm. *Monobromhexamethylene* could not be obtained by direct bromination of hexamethylene either with or without the aid of a bromine carrier. A small quantity was however prepared by the action of an aqueous solution of hydrobromic acid on tetrahydrobenzene. It is a colourless liquid which boils with slight decomposition at 162—163°. The present work will be continued with the view of preparing further derivatives of hexamethylene.

57. "The yellow colouring matter of the leaves of Arctostaphylos uva ursi." By A. G. Perkin.

Kawalier (*Jahr.*, 1852, 685) found the leaves to contain, besides gallic acid and arbutin, a glucoside ericolin, $C_{34}H_{56}O_{21}$, which yields on decomposition ericinol, $C_{10}H_{16}O$, and a sugar. More recently, B. Degraffe (*Am. Jour. Phar.*, 1896, **68**, 313) has identified the tannin as gallotannin. There is also present a yellow colouring matter of the composition $C_{15}H_{10}O_7$, crystallising in glistening yellow needles; this forms an acetyl compound, $C_{13}H_5O_7Ac_5$, melting at 188—190°. On fusion with alkali, phloroglucinol and protocatechuic acid were formed. Though resembling quercetin in these points it has the property of forming deep green solutions with dilute potassium hydrate. Regarding this reaction as due to impurity, the colouring matter was converted (*a*) into a sulphate, and (*b*) into an acetyl-derivative, and the colouring matter regenerated from these, but in each case it was unaltered in its behaviour towards alkaline solutions. Oxidation in alkaline solution did not destroy the green coloration until complete decomposition of the colouring matter had taken place. The presence of ellagic acid has also been detected, and thus besides gallotannin, ellagitannin is also present. Broach leaves contain the same colouring matter.

58. "The yellow colouring matters of various adulterants of Sicilian sumach." Part V. By A. G. Perkin and P. J. Wood.

This paper describes an investigation of the leaves of those plants which are employed for the adulteration of Sicilian sumach (*Rhus coriaria*). We are indebted for samples of these to Mr. P. Gennadius, Director of Agriculture in Cyprus.

The leaves of *Pistacia lentiscus* (shinia) contain a colouring matter of the formula $C_{15}H_{10}O_8$, forming an acetyl compound, $C_{15}H_4O_8Ac_6$, crystallising in colourless needles (m. p. 204—206°). As on decomposition this yields gallic acid and phloroglucinol, it is identical with myricetin, the colouring matter of *Rhus coriaria*. Two tannins appear

to be present: one dissolves in ethylic acetate, yields gallic acid on decomposition, and is evidently gallotannic acid; the other is insoluble, and forms acetic acid, phloroglucinol, and gallic acid on fusion with alkali. When digested with dilute sulphuric acid, the latter yields a red product resembling the anhydrides of the catechol tannins. The further examination of this tannin is reserved. Shinia leaves contain 11·3 per cent. of tannin, and appear to be a useful tanning agent, though not suitable for the same purposes as sumach.

The leaves and stems of *Tamaris gallica* and *T. africana* (bruca) contain the same colouring matter. It has the formula $C_{16}H_{12}O_7$, and forms an acetyl compound (m. p. 169—171°). Decomposition with alkali gave phloroglucinol and protocatechuic acid, and with hydriodic acid quercetin and a molecular proportion of methylic iodide were formed. This substance appears to be a new *methyl ether* of *quercetin*, distinguished from rhamnetin and isorhamnetin by its ready solubility in alcohol. So little of it was available for examination that its absolute purity could not be guaranteed. The tannin (8·4 per cent.) is evidently a mixture of ellagitannin and gallotannin, for both ellagic and gallic acids were isolated as its decomposition products.

The leaves of *Ailantus glandulosa* contain quercetin. The tannin present (11·9 per cent.) is a mixture of ellagitannin and gallotannin, for both ellagic and gallic acids were isolated. This is a worthless tanning agent; the skin though stained a deep colour is practically untanned.

The colouring matter of the leaves of *Ficus carica*, the common fig tree, though resembling quercetin, could not be identified, as from 2 kilos. only 0·08 gram of the substance was obtained. It is nearly devoid of tannin (analysis gave 1·6 per cent.), skin being untanned though stained a dirty olive colour.

Gambuzzo, the stalks of the *Rhus coriaria*, contain a trace of myricetin and some gallotannic acid.

Broach leaves are employed in South Africa in place of sumach (*R. coriaria*), and are also replacing Cape sumach (*Colpoon compressum*) (*Trans.*, 1897, 71, 1132). They contain 19·9 per cent. of a catechol tannin, and they form a valuable tanning agent. The colouring matter, having the formula $C_{15}H_{10}O_7$, forms an acetyl compound, m. p. 188—190°, and on decomposition yields phloroglucinol and protocatechuic acid. It differs from quercetin in its reaction with dilute alkali forming deep green solutions, and appears to be identical with the colouring matter of *Arctostaphylos uva ursi* (see preceding abstract).

The galls of *Pistacia terebinthus* contain a trace of myricetin, whereas Mangrove cutch (*Ceriops candolleana*) is devoid of yellow colouring matter.

59. "The hydrolysis of starch by acids." By Harold Johnson.

It has been generally believed that the hydrolysis of starch by acids is similar in character to that effected by diastase, except that the maltose, which is the final product of the action of diastase, is transformed by acids into dextrose. An examination of the products of acid hydrolysis shows, however, that these are not identical with those of diastase conversion, and that when starch is hydrolysed by dilute acids there is neither production of amyloins (molecular aggregates of maltose and the amylin group) nor of maltose. The nature of the products resulting from the reaction can be shortly described as follows.

The cupric-reducing powers and specific rotations of the intermediate substances (fractionated by means of alcohol) as well as those of the total products of conversion, can be expressed exactly in values of dextrose and the amylin group. The relation between the specific rotation and the cupric-reducing power is constant throughout the whole of the reaction, and, given one of these values, the other may be calculated by the equation, $[\alpha]_{D\cdot 5\cdot 86}x^{\circ} = 195 - (195 - 52{\cdot}8)K_{\frac{5}{3\cdot 86}}/100$, in which x = the specific rotation, and K = the cupric-reducing power in terms of the percentage of dextrose.

The specific rotations of the intermediate substances (separated from the dextrose by precipitation with alcohol) vary between $[\alpha]_{D\cdot 5\cdot 86}$ 80° and 190°. It should be remembered that the intermediate compounds in diastase conversions have rotations which vary from $[\alpha]_{D\cdot 5\cdot 86}$ 190° to 150°, so that the substances from the acid conversions with rotations which fall as low as 80° must differ in character from those obtained by diastase.

The behaviour of the intermediate substances from the acid conversions, when submitted to dialysis, shows that they are definite compounds, and not mixtures of dextrose and other carbohydrates, as, after purification, they dialyse without undergoing a change in specific rotatory power. Moreover, they are unfermentable in the presence of Saaz and Apiculatus yeasts. When treated with phenylhydrazine acetate, they yield gummy precipitates, and on further hydrolysis with acids are completely transformed into dextrose. Their solubility in alcohol decreases as their specific rotation increases.

The products of acid conversion also differ in a marked degree from those of diastase conversion when submitted to the action of diastase. The fall in specific rotation in the case of the products of acid conversion is extremely limited at any time during the reaction. Thus the action of diastase on an acid conversion whose rotation has fallen to $[\alpha]_{D\cdot 5\cdot 86}$ 115° is nil. At 140° the fall is 5° or 6°. At 170° the fall is

about 10°, the blue coloration produced by iodine disappearing at this point in the conversion under the influence of diastase. As, however, diastase has a slight degrading action on conversions which give no blue coloration with iodine, and have rotations between 140° and 115°, it is possible that an unreducing dextrin may be produced in the splitting up of the starch molecule; the slight fall in the rotation under the influence of diastase could then be explained by the degradation of this dextrin.

The action of dilute acids on starch can be expressed in its simplest form by the following equations,

$$(C_{12}H_{20}O_{10})_n + 2(H_2O)_m = \left\{ \begin{matrix} (C_{12}H_{20}O_{10})_{n-m} \\ (C_6H_{12}O_6)_m \end{matrix} \right. + (C_6H_{12}O_6)_m,$$

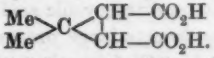
$$\left\{ \begin{matrix} (C_{12}H_{20}O_{10})_{n-m} \\ (C_6H_{12}O_6)_m \end{matrix} \right. + (C_6H_{12}O_6)_m + 2(H_2O)_{n-m} = 2(C_6H_{12}O_6)_n.$$

Taking into consideration their properties, the substances intermediate between starch and dextrose may be regarded as molecular aggregates of dextrose and the amylin group $(C_{12}H_{20}O_{10})_n$; the name *gluco-amylins* will accurately describe them. Gluco-amylins with rotations of about $[\alpha]_{D\,3\cdot36}$ 80° or 90° have been recognised in commercial glucose under the name of gallisin.

The formation of gluco-amylins by acid hydrolysis is thus explained: acids, being able to hydrolyse free maltose, exercise this action also on the maltose in molecular aggregates, and therefore amyloins at the moment of their formation would be transformed into dextrose and gluco-amylins. The molecule of starch is probably formed by the condensation of a large number of molecules of dextrose. In the first place, two molecules of dextrose condense to form maltose, and then a large number of maltose molecules further condense to form starch.

60. "Synthesis of cis- and trans-caronic acid." By W. H. Perkin, junr., and J. F. Thorpe.

The cis- and trans-modifications of caronic acid were obtained by Baeyer (*Ber.*, 1896, **29**, 2796), by oxidising carone with alkaline permanganate, and as these acids when heated with hydrochloric acid yield terebinic acid, Baeyer concluded that they are the cis- and trans-forms of dimethyltrimethylenedicarboxylic acid,



The authors have succeeded in synthesising these acids in a manner which proves that they have the constitution assigned to them by Baeyer.

When the anhydride of $\beta\beta$-dimethylglutaric acid is brominated

and the product poured into ethylic or methylic alcohol, the following ethereal salts are easily obtained. *Ethylic α-bromodimethylglutarate*, $CO_2Et{\cdot}CHBr{\cdot}CMe_2{\cdot}CH_2{\cdot}CO_2Et$, is a colourless liquid boiling constantly at 180° (30 mm.); the corresponding *methylic salt* distils at 155° (22 mm.). The *acid ethylic salt* of α-bromodimethylglutaric acid, $CO_2H{\cdot}CHBr{\cdot}CMe_2{\cdot}CH_2{\cdot}CO_2Et$, is a thick oil distilling without decomposition at 240° (35 mm.). *Methylic aa'-dibromodimethylglutarate*, $CO_2Me{\cdot}CHBr{\cdot}CMe_2{\cdot}CHBr{\cdot}CO_2Me$, is a colourless, somewhat viscous liquid boiling at 172° (22 mm.). The methylic and ethylic salts of α-bromodimethylglutaric acid and the acid ethereal salt above described, yield, on treatment with alcoholic potash, a mixture of acids which melts at 180—200°, and consists of a mixture of the cis- and trans-modifications of caronic acid. The two modifications may be separated by taking advantage of the difference in solubility of their ammonium salts in hot alcohol, as suggested by Baeyer. The sparingly soluble ammonium salt yields trans-caronic acid, which crystallises from water in lustrous prisms melting at 212°. This acid gives a sparingly soluble crystalline silver salt, but does not form an anhydride. From the readily soluble ammonium salt, cis-caronic acid is obtained in plates melting at 174°, and yielding an anhydride melting at 54—56°. There can be no doubt that these acids are identical with the caronic acids prepared by Baeyer.

The authors are investigating the action of the bromo-ethereal salts described above on the sodium derivative of ethylic malonate.

61. "Preparation of solid ammonium cyanate." By James Walker and John K. Wood.

In connection with previous experiments on urea-formation (*Trans.*, 1895, 67, 746; 1897, 71, 489), it was thought desirable to make an attempt to prepare ammonium cyanate in the solid state. Liebig and Wöhler (*Ann. Phys. Chem.*, 1830, [ii], 20, 393), by passing the vapour of cyanic acid into dry ammonia, obtained a product which they held to be a basic ammonium cyanate. From the description of their experiments, it appears likely that what they actually had in their hands was the normal ammonium cyanate mixed with considerable quantities of urea and of cyamelide. The reason why they did not succeed in preparing the normal cyanate in the pure state is that the heat of combination of the ammonia and the cyanic acid is so great that, under the conditions chosen by them, a large proportion of the ammonium cyanate was decomposed, with formation of the above impurities and of ammonia. If this heating is avoided, it is a matter of no great difficulty to prepare the cyanate in a state which nearly approaches purity. A solution of ammonia in anhydrous ether is gradually added

to a solution of cyanic acid in anhydrous ether, both solutions being cooled to $-20°$. A gelatinous precipitate at once separates, which, after rapid filtration and removal of adhering ether, shrinks to friable masses of a pure white solid. If moisture is rigorously excluded during the operations, and the temperature never allowed to rise to the freezing point, the product is practically pure ammonium cyanate. When freshly prepared, it dissolves in water without residue, yielding a solution which is neutral to litmus. This proves that the product is free from cyamelide and ammonia, and the only impurity to be feared is urea. The substance effervesces on treatment with nitric acid, and no urea nitrate separates. Silver nitrate solution produces a white precipitate, which is soluble in boiling water and separates out on cooling, thus exhibiting the properties of silver cyanate. Portions of the salt on being analysed as soon after their preparation as possible gave the following numbers, the cyanate radicle being estimated as silver cyanate.

	Found.	Theory for ammonium cyanate.
NH_4	30·0	30·0
CNO	70·9	70·0
N	46·8	46·7
C	19·8	20·0
H	7·0	6·7

The cyanate may be kept for a long time in closed tubes without undergoing any considerable alteration. Thus a portion which had remained at the ordinary temperature for fourteen days still contained over 95 per cent. of cyanate. On heating in a melting point capillary, the cyanate contracts visibly at a temperature somewhat above 60° and melts suddenly at a temperature varying between 76° and 89°, according as the heating is conducted rapidly or not, and according to the tightness with which the material is packed. The fused mass, however, immediately solidifies, and does not again melt till a temperature of 128° is reached—urea melting at 132°. A minute quantity of gas is given off during the first fusion, and a litmus paper introduced into the upper part of the tube is then turned blue. When the experiment is made on a larger scale, a smell of ammonia is perceptible. Corresponding to this liberation of ammonia, it is found that the transformed solid is not entirely soluble in water, a slight flocculent residue of cyamelide remaining. The first fusion observed when the substance is heated doubtless results from the rapid transformation of cyanate into urea, enough heat being evolved to liquefy the urea produced, which thereafter cools to a temperature below its melting point. The contraction at first observed probably indicates the temperature at which the transformation proceeds at a perceptible rate. After 5 hours at

61°, a portion of the cyanate was found to be almost wholly transformed into urea, a small quantity of ammonia and cyamelide being formed at the same time. Twenty hours' heating at 43° effected the transformation of only 28 per cent. of the cyanate. On opening the tube, it was again found that ammonia had been produced, and that the residue was not completely soluble in boiling water. The transformation of the solid cyanate into urea seems, therefore, to be always accompanied by a subsidiary transformation into cyamelide and ammonia.

The investigation is being continued with a view to determining the accurate temperature of transformation of the cyanate, if this is possible, and also to effect the preparation of alkyl ammonium cyanates by similar means.

62. "The chlorine derivatives of pyridine. Part I." By William J. Sell, M.A., F.I.C., and F. W. Dootson, M.A.

The authors have examined the action of phosphorus pentachloride on pyridine, and have isolated the following compounds. (1) A dichloropyridine, m. p. 87—88°; (2) a trichloropyridine, m. p. 49—50°; (3) a trichloropyridine, m. p. 71—72°; (4) a trichloropyridine, m. p. 67—68°; (5) a tetrachloropyridine, m. p. 90—91°; (6) a tetrachloropyridine, m. p. 21—22°; (7) a tetrachloropyridine, m. p. 74—75°; (8) pentachloropyridine, m. p. 123—124°.

63. "Simple experimental illustration of the law of multiples." By A. Wentworth Jones, M.A.

Calculated quantities—for example, four times the milligram-molecules—of potassium chlorate and perchlorate are weighed into hard glass tubes provided with corks and delivery tubes, each passing by india-rubber connections through the hole in a beehive-shelf, to near the top of a graduated gas jar full of water in the pneumatic trough. After heating the tubes in the full bunsen flame for a few minutes, gas ceases to come off, the flames are removed, and the tubes allowed to cool and to withdraw their original content of gas from the receivers through the upturned delivery tubes. The relative volumes collected stand, of course, in the proportion 3 : 4 for equal weights of residue in the tubes. In an experiment before a class, the volumes obtained were 146 and 194 c.c., *i.e.*, in the proportion of 3 : 4 almost exactly. After weighing tubes and residues, and then cleaning and weighing the tubes, the difference or weight of residue was, in each case, 0·30 gram.

64. "Lauronolic acid." By R. W. Collinson and W. H. Perkin, junr.

In connection with the experiments made by one of the authors on isolauronolic acid, they have lately examined lauronolic acid with the following results.

Lauronolic acid is not reduced by sodium amalgam, but when treated with hydrobromic acid is converted into a hydrobromide, $C_9H_{15}O_2Br$, which melts at about 133° with decomposition, and when treated with bromine in chloroform solution, yields a substance which melts at 185° and seems to have the composition $C_9H_{13}O_2Br$.

Boiling with dilute nitric acid converts lauronolic acid into a substance of the formula $C_9H_{18}(NO_2)O_2$, which is volatile in steam, and melts at 170°.

When a cold solution of the sodium salt of lauronolic acid is oxidised with potassium permanganate, a syrupy acid of the formula $C_9H_{14}O_5$ is produced, which is at present under investigation.

Lauronolic acid, when warmed with sulphuric acid at 30—40°, is completely decomposed, carbon monoxide being formed together with substances which so far have not been investigated.

65. "The action of aluminium chloride on camphoric anhydride." By Frederic H. Lees and W. H. Perkin, junr.

In the course of experiments on isolauronolic acid, on which one of the authors has been engaged for some years, an attempt was made tc prepare this acid by a method described by G. Blanc (*C. R.*, 1896, **123**, 749—752, *Bull. Soc. Chim.*, 1896, [iii], **15**, 1191—1199), which consists in acting on a solution of camphoric anhydride in chloroform with aluminium chloride. For a long time the authors failed to obtain anything like the yield of isolauronolic acid obtained in this way by Blanc (40 per cent.), and on investigating the cause of this discrepancy, they have isolated the following new substances as products of the reaction. (1) A *neutral oil* corresponding to about 30—40 per cent. of the camphoric anhydride employed. This substance, which the authors propose to call *ψ-campholactone*, boils constantly at 163—164° (50 mm.), has the formula $C_9H_{14}O_2$, and is isomeric with lauronolic acid, isolauronolic acid and campholactone. It is converted by treatment with potash into the corresponding hydroxy-acid, $C_8H_{14}(OH)CO_2H$, a thick syrup which readily loses water, reforming the lactone. When *ψ*-campholactone is heated with concentrated sulphuric acid at 90°, sulphur dioxide is evolved, and on adding water a crystalline acid is precipitated in quantity; this melts at 126°, and proves to be xylic acid, $C_6H_3Me_2CO_2H$ (1 : 3 : 4).

(2) An *acid* melting at 255—257°, which gives numbers on analysis agreeing with the formula $C_{11}H_{16}O_3$.

The authors are engaged in the examination of this acid and of ψ-campholactone, as they hope in this way to obtain results having a direct bearing on the constitution of camphoric acid.

66. "On the action of bromacetal on the sodium derivative of ethylic malonate." By W. H. Perkin, junr., and C. H. G. Sprankling.

For some months the authors have been engaged in the examination of this decomposition, and although their experiments are far from complete, they wish to give a short account of the results as yet obtained, in view of a recent paper by Harries (*Ber.*, 1898, **31**, 37), which deals with substances somewhat similar to those obtained by them.

Bromacetal has little action on the sodium derivative of ethylic malonate at 100°, but when these substances are heated at 140—150° in sealed tubes, interaction takes place readily with the formation of ethylic acetalmalonate.

Ethylic acetalmalonate, $(CO_2Et)_2CH\cdot CH_2\cdot CH(OEt)_2$, boils constantly at 151—154° (15 mm.), and on hydrolysis with alcoholic potash yields the corresponding *acetalmalonic acid*, $(CO_2H)_2CH\cdot CH_2\cdot CH(OEt)_2$, a colourless syrup, which when heated with water at 190° is decomposed with elimination of carbon dioxide and alcohol, and formation of a substance, which is apparently the half aldehyde of succinic acid, $CO_2H\cdot CH_2\cdot CH_2\cdot CHO$. This is a colourless syrup, which on long standing deposits crystals, reduces Fehling's solution, combines with phenylhydrazine, and yields succinic acid on oxidation with nitric acid

The authors are investigating these substances, as well as the action of bromacetal on the sodium derivatives of other ethereal salts.

67. "The sulphonation of benzophenone and of diphenylmethane." By Arthur Lapworth, D.Sc.

Benzophenone, as it contains the group –CO– in direct attachment to the benzene nucleus, should afford a considerable quantity of meta-acid on sulphonation. It has long been supposed that the major portion of the product was the para-disulphonic acid, as Städel obtained parahydroxybenzoic acid on fusing it with alkali (*Ann.*, 1878, **194**, 134). The author has been unable to confirm Städel's observation; the disulphonic acid he obtained by sulphonation yielded almost pure metahydroxybenzoic acid on fusion with alkali, and there is therefore, no reason to regard the behaviour of benzophenone on sulphonation as exceptional. During the investigation the following substances were obtained and characterised. Benzophenonedisulphonic chloride, $C_{13}H_8O(SO_2Cl)_2$, crystallises from chloroform in large, anorthic plates melting at 138°, and the form, described by Beckmann, melting

at 121·5° could not be obtained. The *amide* forms needles melting at 157°, and the *anilide* large crystals melting at 177—178°. The *piperidide* crystallises in monoclinic prisms or plates melting at 168°, and has the curious property of forming a transparent jelly when its alcoholic solution is slowly cooled. A brief study of the sulphonation products of diphenylmethane was made. They appear to be a mixture of disulphonic acids, of which one, doubtless the dipara-acid, yields a *chloride*, $C_{13}H_{10}(SO_2Cl)_2$, melting at 124°, an *anilide* melting at 178°, and a *piperidide* melting at 171—172°. When the sulphonation is carried out by means of chlorosulphonic acid, *diphenylmethaneorthosulphone*, $C_{13}H_{10}SO_2$, is also produced; its constitution follows from the fact that, when oxidised, it yields the benzophenonesulphone described by Städel, the structure of which has been determined.

68. "The separation of optical isomerides." By Frederic Stanley Kipping and William Jackson Pope.

In a previous paper ("Racemism and Pseudoracemism," *Trans.*, 1897, 71, 989), the authors have dealt with a number of the properties of optically active compounds and their externally compensated isomerides. It would seem, however, that much may be learnt respecting the mutual relationships of these substances by a study of their respective behaviour towards solvents which are themselves optically active. In this preliminary note, the authors record the results obtained up to the present in some experiments on the separation of a mixture of equal quantities of enantiomorphously related substances by crystallisation from optically active solvents. The first attempts which the authors made to effect such a separation were unsuccessful; inactive mandelic acid, for instance, crystallised unchanged from an aqueous solution of dextrose. Since, however, inactive mandelic acid is a well-defined racemic compound at ordinary temperatures, it might well be that the tendency to form a solid racemic compound would overcome any tendency towards separation due to the presence in the system of a third enantiomorphous substance; the authors were therefore led to attempt the separation of an externally compensated mixture of two substances which do not form a solid racemic compound at the temperature employed. These experiments were successful.

An externally compensated mixture of sodium ammonium dextro- and lævo-tartrate forms a solid racemic compound only above 27°, and when crystallised from water at ordinary temperatures crystals of the dextro- and lævo-isomerides separate in equal quantities side by side, and may be mechanically separated. The authors find, however, that when an optically inactive mixture of sodium ammonium dextro- and lævo-tartrates is dissolved in a concentrated aqueous solution of dextrose, and crystallisation allowed to take place spontaneously at ordinary

temperatures (below 27°), the crystalline deposit which first separates contains a very considerable excess of the dextrorotatory salt; when freed from dextrose, first by recrystallisation from water at ordinary temperatures, and then by fractional precipitation from a warm aqueous solution by alcohol, this first deposit yields a quantity of sodium ammonium tartrate having a high specific dextrorotation. Eleven samples of salt, each obtained from a different solution, have so far been examined; in only one case the salt separated by the method just described was optically inactive, whilst in all the others it was dextrorotatory. Full quantitative details will be published later, but to afford some idea of the extent to which separation occurs, the authors find that from 175 grams of a crystallised optically inactive mixture of sodium ammonium dextro- and lævo-tartrates, treated as above in six separate and approximately equal portions, they obtained the following six samples of hydrated active salt.

	1	2	3	4	5	6
Weight in grams.	3·2	3·8	3·0	3·7	4·2	3·5
$[\alpha]_D$	+15·50°	+22·07°	+22·97°	+23·30°	+20·65°	+10·56°

Landolt's value for the specific rotation of sodium ammonium dextrotartrate calculated on the hydrated salt is $[\alpha]_D = 23·70°$. The authors have satisfied themselves that all the samples examined in the polarimeter were free from dextrose, and that the racemic acid used in making the salt was optically inactive. The results thus briefly recorded seem to show that enantiomorphously related substances are not equally soluble in presence of a third enantiomorphous substance; whether the difference under these conditions will be sufficient in all cases to render a separation of the two isomerides possible, thus adding another to the few methods by which this may be accomplished, is a matter which is still under investigation.

At the next meeting, on Thursday, May 5th, the following papers will be communicated by the authors.

"The reactions of the carbohydrates with hydrogen peroxide." By C. F. Cross, E. J. Bevan, and Claud Smith.

"The properties and relationships of dihydroxytartaric acid. Part II." By H. J. H. Fenton, M.A.

"The affinity constants of certain hydroxy-acids." By S. Skinner, M.A.

"Molecular weights in solution of permanganates, perchlorates, and periodates." By J. Murray Crofts, B.A., B.Sc.

RICHARD CLAY AND SONS, LIMITED LONDON AND BUNGAY.

Issued 12/5/1898.

PROCEEDINGS
OF THE
CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 194. Session 1897–8.

May 5th, 1898. Professor Dewar, F.R.S., President, in the Chair.

Messrs. E. C. Jee, W. Marshall, and T. H. Pope were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Harry Brearley, Totley, Derbyshire; Arthur Stanley Hemmy, Government College, Lahore; Leonard Myddleton Nash, 281, Seven Sisters' Road; Finsbury Park, N.; Edward John Russell, Owens College, Manchester; Sigmund Stein, 323, Vauxhall Road, Liverpool; Frank Edwin Weston, 43, Larkhall Rise, Clapham, S.W.; William Williamson, 86, Tyndall Road, Leyton, E.; Charles Arthur Wrench, 3, Parklands, Surbiton Hill.

Of the following papers those marked * were read:—

***69. "The action of hydrogen peroxide on carbohydrates in the presence of iron." By C. F. Cross, E. J. Bevan, and Claude Smith.**

The results obtained by H. J. H. Fenton (*Trans.*, 1894, **65**, 899; 1895, **67**, 48; 1896, **69**, 546) in oxidising tartaric acid by hydrogen peroxide in presence of soluble iron compounds suggested the application of the method to other hydroxy-compounds, and notably to the carbohydrates. The authors have studied the behaviour of typical hexoses and of cane-sugar, when treated in aqueous solution with hydrogen peroxide at ordinary temperatures, and, in confirmation of Fenton's observations, have found in this group also that the presence of iron compounds is an essential condition for the production of the characteristic reactions. A convenient proportion of iron (Fe as

$FeSO_4 \cdot 7H_2O$) is 1/10000 of the weight of a solution containing 4 grams of the carbohydrate in 100 c.c. The authors reserve for the present any statement of the limiting proportion which may be necessary, and are engaged in ascertaining whether other inorganic compounds may not be found to have similar effects.

With such proportions and with hydrogen peroxide in quantities sufficient to supply 1 or 2 atoms of oxidising oxygen for each molecule of hexose, reaction takes place readily with marked rise of temperature (10—20°), but in the absence of iron compounds, all other conditions remaining the same, nothing happens at ordinary temperatures. After reaction, the solutions are acid to the taste. The quantity of acid formed is greater from dextrose than from lævulose. The volatile acids separated by distillation are formic and acetic acids, and represent 15—20 per cent. and 4—7 per cent. respectively of the weight of the dextrose. The non-volatile acids represent about one-half the total acidity, and contain a dicarboxylic acid which is easily isolated by precipitation as lead salt in the presence of acetic acid, and on analysis gives numbers corresponding with those required for tartronic acid.

After removal of the acids, the presence of furfuroids is identified by estimations of furfural in the distillates from hydrochloric acid (sp. gr. 1·08). The quantities obtained from dextrose or cane-sugar are 3—4 per cent., representing 7—9 per cent. of the furfuroid. The products yielding furfural are not acid in character, but there is no evidence that they are pentoses. From lævulose, only traces of these products are formed. The solutions give a well-marked iodoform reaction, indicating that the hexose molecules undergo internal rearrangement, and that the phenomena are not those of a simple oxidation.

The characteristic products of the reaction are separated from solution by the addition of alcohol and ether; on drawing off the denser aqueous layer, a solution is obtained which dries in a vacuum to a gummy solid, destitute of any appearance of crystallisation. These compounds react with phenylhydrazine acetate in the cold, forming osazones, and give evidence of the presence of highly reactive groups by reducing Fehling's solution in the cold. The yield of osazones is considerable, amounting to 30—60 per cent. of the weight of the carbohydrate in the case of lævulose and of cane-sugar; and to 12—20 per cent. in that of dextrose. Two groups of osazones have been obtained, (1) compounds melting at 185—195° and resembling the glucosazones in properties, but differing from them in composition, the nitrogen (N = 17—20 per cent.) being 2—3 per cent. higher; (2) compounds with a low melting point (130°), and freely soluble in hot water. From these results, it might be inferred that the products are the

"osones" or "oxyglucoses" of Fischer, but they resist the action of zinc and acetic acid on the one hand, and of bromine on the other, and are not reduced by sodium amalgam in solutions kept slightly acid; properties which differentiate them from the normal carbohydrates and from such of their oxy-derivatives (ketaldoses) as are at present known.

The investigation of the nature of these products is complicated by the fact that no crystalline derivatives other than the osazones have been obtained. No definite acetates or benzoates have been isolated. Some evidence as to their relationship to the original hexoses, however, is obtainable from a closer study of the constants of the reaction. It appears, in the first place, that there is no simple proportion between the quantity of hydrogen peroxide employed and the amount of the characteristic products obtained. Having established this for quantities representing 3, 2, and 1 atom of oxygen for each molecule of the hexose, the authors found that very considerable effects were still produced on further reducing the proportion of peroxide. Thus from 40 grams dextrose treated with sufficient peroxide to furnish only 1/10 atom of oxygen for each molecule of hexose, the quantity of osazones formed in the cold from the product of the reaction was 8 grams, an amount as great, therefore, as that obtained when 10 times this proportion of the peroxide was employed. Similarly, the addition of still smaller quantities of the peroxide to a dextrose solution was found to convert a considerable proportion of the hexose into compounds not fermented by yeast, though reducing Fehling's solution and otherwise resembling the compounds just described.

The authors conclude (1), that hydrogen peroxide acts primarily by determining a constitutional change in the hexose molecule, *i.e.*, by internal rearrangement, such effects bearing no direct proportion to the quantity added, and (2), that the oxidising actions observed, *e.g.*, the formation of dicarboxylic acids, are subordinate or secondary effects.

As regards the nature of the constitutional changes in question, the reactions of the characteristic products indicate the presence of –C(OH):C(OH)– groups. In the formation of dihydroxymaleic acid from tartaric acid, this radicle results from an actual removal of hydrogen by oxidation, and in the carbohydrates might be formed by internal rearrangement. The authors consider that such a change is the primary effect of contact with the peroxide, although –CH(OH)·CH(OH)– residues also are probably attacked and hydrogen eliminated by direct oxidation.

The obvious bearings of these results upon the problem of plant physiology, from which point of view they are positive and sufficiently

established, induce the authors to put forward this preliminary communication without waiting for a definite solution of the constitutional problems, which are still under investigation.

Discussion.

Dr. Armstrong referred to the interest of the work in connection with vegetable physiology, indicative as it was of the far-reaching character of the interactions concerned in the elaboration of the products of plant activity. Although the part played by enzymes in such processes had been generally recognised, their importance must be much accentuated now that Buchner's remarkable discovery of an enzyme capable of inciting alcoholic fermentation was placed beyond doubt. It seemed quite possible, from the experiments of Mr. Cross and his colleagues, that iron, which is known to be present in most plants, may behave to some extent as an enzyme and thus possess unexpected importance from the point of view of plant chemistry; it was very noteworthy from this point of view that the formation of reduction products yielding iodoform had been observed as well as that of oxidation products.

Dr. Morrell stated that, with galactose, the disappearance of hydrogen peroxide is twice as rapid as with glucose, and that the addition of large quantities of the peroxide caused a marked rise of temperature. Ferrous iron, which could not be detected during the oxidation, reappeared when hydrogen peroxide could be recognised no longer in the solution.

Mr. Fenton said that, since he had observed the peculiar influence of iron in the oxidation of tartaric acid, experiments had been made in other directions, and as so wide a field had been opened up for investigation the co-operation of the authors and of Dr. Morrell was most welcome.

Mr. Ling, referring to the possible analogy between the products of the reaction described by the authors and those formed by the oxidation of sugars by alkaline copper solutions, said that Kjeldahl had observed that glucose and fructose, when boiled with a solution of potassio-copper sulphate (Ost's solution), yield mesoxalic acid. Kjeldahl had also shown that this acid, on treatment with phenylhydrazine acetate, is converted into a dihydrazide melting at 148°,—a derivative, therefore, of dihydroxymalonic acid. Might not the supposed osazone, which was formed in the cold, be a substance of this kind?

Mr. Cross, in reply, stated that the phenylhydrazine derivatives obtained in the cold had the characteristics of osazones, although

neither aniline nor ammonia, which according to Fischer are simultaneously produced in the osazone reaction, could be detected in the filtrates. It had not escaped attention that the derivatives might possibly be hydrazides resulting from condensation with a –C(OH):C(OH)– group, and they were being investigated from this point of view.

***70. "Note on the oxidation of certain acids in presence of iron." By Henry J. Horstman Fenton, M.A.**

It has been shown in several previous communications (*Trans.*, 1894, **65**, 899; *B. A. Report*, 1895, &c.) that when tartaric acid is oxidised in presence of a small quantity of ferrous iron, one molecule of the acid loses two atoms of hydrogen, giving rise to dihydroxymaleic acid. The most effective oxidising agent for the purpose is hydrogen dioxide, but the result is also brought about by chlorine, hypochlorites, bromine, &c., and by atmospheric oxygen in presence of sunlight. The presence of ferrous iron is essential, but its proportion seems to bear but little relation to the yield of acid in the ordinary course of preparation, the action being, in fact, what is usually termed catalytic. It is necessary that the addition of iron shall precede that of the oxidising agent. From the fact that dihydroxymaleic acid, on heating with water, yields glycollic aldehyde, and that this readily condenses to a hexose, it is evident that the change may afford information with regard to the natural formation of carbohydrates.

The production of dihydroxymaleic acid from tartaric acid is most easily represented by assuming the removal of the two non-hydroxylic hydrogen atoms: $C_2H_2(OH)_2(CO_2H)_2 - H_2 = C_2(OH)_2(CO_2H)_2$. It is true that dextrotartaric acid would be expected, in this manner, to yield a fumaroid instead of a maleoid acid; but it is quite possible that 'stereomeric' change takes place during one of the stages of preparation, and in any case this objection can hardly be considered a serious one, bearing in mind the large number of known exceptions (Michael, *J. prakt. Chem.*, 1892, **46**, 400).

While seeking for a chemical explanation of the part played by the iron, the following may be offered as a provisional suggestion. The two non-hydroxylic hydrogen atoms in tartaric acid may be supposed to possess feebly acid functions owing to the neighbourhood of the CO_2H– and OH– groups, and it is possible that an atom of divalent iron may replace these two hydrogen atoms, giving the compound: $CO_2H\cdot C(OH)\langle^{Fe}\rangle C(OH)\cdot CO_2H$. On addition of the oxidising agent the iron atom assumes the trivalent state, and can therefore no longer be 'retained.' The result is an unsaturated acid, and the iron enters into solution as a ferric salt, *e.g.*, ferric tartrate. Dihydroxymaleic

acid readily reduces ferric salts in the cold, experiment indicating that two atoms of iron are reduced by one molecule of the acid, so that the ferrous iron is regenerated at the expense of a portion of the acid.

A large number of the commoner acids have been investigated as regards their behaviour in this respect. In addition to all the non-hydroxylic acids examined, lactic, malic, citric, and tartronic acids give negative results. If, however, the above explanation be accepted, it is evident that the production of the violet coloration would only be expected in the case of those acids the molecules of which contain at least two CH(OH)– groups. Mucic and saccharic acids might therefore be expected to yield positive results, and recent experiments have shown that this is the case. Both these acids, when treated in the cold with a limited quantity of hydrogen dioxide in presence of ferrous iron, give intense violet colorations. Attempts are being made to isolate the oxidation products, which appear to be even less stable, however, than dihydroxymaleic acid.

Discussion.

Dr. Armstrong thought a more probable explanation of the part played by iron to be that the iron salt became added to the carboxylic group; if changes then occurred such as he had suggested take place when optical inversion is effected by hydrolytic agents (*Trans.*, 1896, 69, 1399), it would be easy to understand why dihydroxymaleic acid was obtained instead of the fumaric derivative.

Mr. Fenton, referring to the suggestion he had made, said that replacement of non-hydroxylic hydrogen atoms by metals might also occur in Fehling's and other similar solutions. In experiments with equal molecular quantities of dihydroxytartrates and tartrates, it had been found that the power of retaining copper in solution in the presence of alkali is very much greater in the latter case, although the reverse might be expected if replacement occurs in the alcoholic hydroxyl groups as is commonly supposed.

***71. "Properties and relationships of dihydroxytartaric acid. Part II. Metallic Salts." By Henry J. Horstman Fenton, M.A.**

The only metallic dihydroxytartrate which appears to have been prepared and studied is the sodium salt—the supposed barium salt being probably a mixture. Several other salts of the acid are now described. It is shown that the solubilities of the normal salts of sodium, potassium, rubidium, and cæsium increase with the rise in atomic weight of the metal. The lithium salt is exceptional, its solubility being greater than that of the sodium salt. The differences

in solubility of these salts may perhaps be of service in separating the metals of the alkalis.

Solutions of soluble dihydroxytartrates act as powerful reducing agents towards salts of silver, copper, and mercury, but are themselves reduced to dihydroxymaleic acid by stannous and ferrous salts.

***72. "The affinity-constants of dihydroxymaleic, dihydroxyfumaric, dihydroxytartaric, and tartronic acids." By S. Skinner, M.A.**

The affinity-constants have been determined from the conductivity of the aqueous solutions. The determination in the case of these acids, with the exception of tartronic acid, presents special difficulty as their solutions undergo gradual decomposition. The constants found are compared with those of malonic, succinic, fumaric, maleic, and tartaric acids, and it is shown that an increase in the value of the constant occurs:—(1) on the introduction of hydroxyl groups; (2) for the lower members of the series of dibasic acids; (3) for the unsaturated acids as compared with their saturated isologues.

Discussion.

Dr. Wallace Walker objected to the explanation given of the nature of the curves on the ground that in the production of carbon dioxide and glycollic aldehyde from dihydroxymaleic acid, the concentration of the supposed catalyser is decreasing at the same rate as that of the negative ion. The reaction would therefore be bimolecular, and its curve not rectilinear but one represented by an equation of the second degree.

Mr. Fenton asked whether the results obtained with dihydroxymaleic acid could be explained by the suggestion, advanced in a previous communication, that combination with a molecular proportion of water occurs on dissolution with the production of the unstable trihydroxysuccinic acid.

Mr. Skinner, in reply, recognised that explanations of the behaviour of dihydroxymaleic acid other than that adopted in the paper were possible, but he was not prepared to say how far they would be of assistance in elucidating the results of the conductivity experiments.

***73. "Note on the enolic and ketonic forms of ethylic acetoacetate." By R. S. Morrell, M.A., Ph.D., and J. M. Crofts, B.A., B.Sc.**

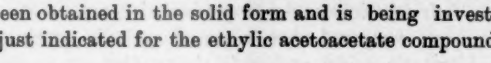
The authors find that the purple oil obtained by the action of anhydrous ferric chloride on ethylic acetoacetate is decomposed by water in the presence of ether into ferric chloride and the ketonic

ethereal salt. The ether is found to contain the ketonic and not the enolic form, as would be expected. To identify the ketonic form, the method given by Schiff and Bertini (*Ber.*, 1898, **31**, 207) is employed. The ethylic benzalanilineacetoacetate is found to have the composition, melting point (78°), and properties of the ketonic form. The tautomeric change is probably due to the fact that the ferric chloride compound of ethylic acetoacetate, when decomposed by water in the presence of ether, produces hydrochloric acid, which converts the enolic into the ketonic form.

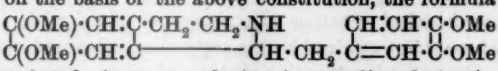
The authors mentioned in a previous paper that ethylic benzaldiacetoacetate formed a purple oil with ferric chloride in benzene solution, whereas, in alcoholic solution, there was no such coloration. This oil has been obtained in the solid form and is being investigated on the lines just indicated for the ethylic acetoacetate compound.

***74. "The resolution of tetrahydropapaverine into its optically active components." By William Jackson Pope and Stanley John Peachey.**

Goldschmiedt has shown that papaverine is optically inactive and is, in all probability, an isoquinoline derivative of the constitution



This formula does not contain an asymmetric carbon atom and, up to the present, no optically active derivative of papaverine has been described. Amongst the derivatives of papaverine prepared by Goldschmiedt (*Monats.*, 1886, **7**, 495) is a tetrahydropapaverine, $C_{20}H_{25}NO_4$, to which, on the basis of the above constitution, the formula



must be assigned, since, on reducing isoquinoline derivatives, hydrogenation takes place in the pyridine nucleus. On this assumption, tetrahydropapaverine contains an asymmetric carbon atom, and it should therefore be possible to separate the optically inactive compound into two enantiomorphously related isomerides, and thus obtain evidence confirming the constitution which Goldschmiedt has assigned to papaverine.

In 'splitting' an externally compensated base into its enantiomorphously related components, the dextrotartrate is almost invariably employed; it would seem preferable, however, on various grounds, to make use in such cases of the dextrobromocamphorsulphonic acid described by Kipping and Pope (*Trans.*, 1893, **63**, 584). Dextrobromocamphorsulphonic acid is a far more powerful acid than tartaric acid, and hence might be expected to yield better characterised and more

easily isolated salts than the latter, with the further advantage that with a monobasic acid there is usually no tendency to form two classes of salts. Dextrobromocamphorsulphonic acid is conveniently prepared from the ammonium salt by conversion into the barium salt and careful precipitation of the solution by sulphuric acid. After filtration, the strength of the resulting solution is determined by titration.

Tetrahydropapaverine is boiled with rather more than the calculated quantity of dextrobromocamphorsulphonic acid dissolved in a large quantity of water. Ultimately, the whole dissolves, and, on cooling, long needles of lævotetrahydropapaverine dextrobromocamphorsulphonate, $C_{20}H_{25}NO_4,C_{10}H_{14}BrO\cdot SO_3H$, crystallise out. Further quantities of this salt are obtained, mixed with increasing quantities of the more soluble dextrotetrahydropapaverine dextrobromocamphorsulphonate, on concentrating the mother liquors. The two salts are readily separated by crystallisation from boiling water.

Lævotetrahydropapaverine dextrobromocamphorsulphonate crystallises readily from water, in which it is sparingly soluble in the cold, in long, colourless, anhydrous needles melting with decomposition at 295—298°; it is somewhat more soluble in absolute alcohol, but insoluble in most other organic solvents. In a 0·3 per cent. absolute alcoholic solution, it has the specific rotation of about $[\alpha]_D = -30°$.

Dextrotetrahydropapaverine dextrobromocamphorsulphonate separates from solution as a resin which could not be obtained crystalline; when purified by repeated separation from its boiling aqueous solution and dried in the air, it forms a gritty, amorphous powder.

Lævotetrahydropapaverine, $C_{20}H_{25}NO_4$, separates on cooling a hot aqueous solution of its dextrobromocamphorsulphonate to which excess of ammonia has been added; it crystallises from boiling dilute alcohol in colourless, minute, six-sided plates containing water which melt at 223°. The large flat face of the crystal is perpendicular to the acute bisectrix of a very small axial angle and of negative double refraction; the material has the specific rotation $[\alpha]_D = -149·5°$ in a chloroform solution containing 0·7987 grams per 25 c.c. The *dextrotetrahydropapaverine* separated from its dextrobromocamphorsulphonate resembles the lævo-isomeride in all respects, but is of opposite rotation.

Inactive tetrahydropapaverine melts at 200—201°, and at ordinary temperatures is crystallographically different from its optically active components; it is, therefore, a racemic compound in the sense of Kipping and Pope's definition (*Trans.*, 1897, 71, 989) It is formed on crystallising a mixture of equal weights of the two optically active isomerides from dilute alcohol.

The salts of racemic, dextro- and lævo-tetrahydropapaverine are being investigated, and experiments on other optically inactive alkaloids and their reduction products are in progress.

75. "Molecular weights of permanganates, perchlorates, and periodates in solution." By J. Murray Crofts, B.A., B.Sc.

The molecular weight of potassium permanganate in solution has been determined only by the specific conductivity method. In view of the close relationship between manganese and chlorine indicated by the periodic classification of the elements, it was thought that further investigation of the molecular weights of these substances in solution would be of interest.

The method adopted was that devised by Löwenherz (*Zeit. physik. Chem.*, 1895, 18, 70), in which Glauber's salt is the solvent employed. In this solvent sodium salts cannot undergo dissociation. The methods by which practically pure crystalline sodium permanganate and the very deliquescent sodium perchlorate were obtained are described. Determinations with both the sodium and the potassium salts of the acids were made, and the results point to the formula $M'MnO_4$ for permanganates, and $M'ClO_4$ for perchlorates. For periodates (meta-periodates) the potassium salt only was used, and the constant obtained indicated KIO_4 as the formula.

The results afford additional evidence for the inclusion of manganese with the halogens in group VII. of the periodic classification. The author is inclined to advocate Spring's formula for perchloric acid (*Bull. Acad. Belg.*, [ii], 39, 887), and a corresponding expression for permanganic acid, the chlorine and manganese atoms being regarded as heptavalent in these compounds.

76. "The action of chlorine on pyridine." By W. J. Sell, M.A., F.I.C., and F. W. Dootson, M.A.

In this communication the results are given of a repetition, in part, of the work of Keiser (*Am. Chem. J.*, 1886, 8, 308), undertaken primarily with the object of comparing his dichloropyridine hydrochloride with the trichloropyridine, melting at 71—72°, obtained by the authors by the action of phosphorus pentachloride on pyridine (*Proc.*, 1898, 14, 110).

In consequence of the results obtained, the work was somewhat extended, and it is shown that (1) an additive compound of chlorine and pyridine is formed, the constitution of which is not yet established; (2) Keiser's dichloropyridine hydrochloride is a trichloropyridine; (3) others of the chloropyridines seem to be formed in small amount; (4) the compound, C_5H_5NCl, described by Keiser as an addition product of chlorine and pyridine, is pyridine hydrochloride.

77. "The oxidation of paranitrotoluenesulphonic acid to dinitrostilbenedisulphonic acid and to paranitrobenzaldehydorthosulphonic acid." By R. Herz and W. H. Bentley.

In this paper the authors describe their experiments on the oxidation of sodium paranitrotoluenesulphonate by sodium hypochlorite. By using much less caustic soda than Green and Wahl (*Ber.*, 1897, 30, 3097), they find that the product of oxidation is almost entirely sodium dinitrostilbenedisulphonate, and that sodium dinitrodibenzyldisulphonate does not appear to be produced. The sodium, silver, barium, and lead salts, as well as the acid, have been prepared and examined.

The authors are unable to accept the views of Ris and Simon (*Ber.*, 1898, 31, 354) on the constitution of the stilbene derivative, and from a determination of the amount of potassium permanganate required for its oxidation, maintain that it is a dinitro- and not a nitrosonitro-compound. They found, independently of Green and Wahl, that, on oxidising sodium dinitrostilbenedisulphonate in the cold with potassium permanganate, sodium paranitrobenzaldehydorthosulphonate is formed. This substance possesses the properties of an aldehyde, and forms yellow, crystalline compounds with phenylhydrazine and semicarbazide.

78. "Determination of molecular weights:—modification of Landsberger's boiling point method." By James Walker and John S. Lumsden.

The authors propose a modification of Landsberger's method (*Ber.*, 1898, 31, 458) which consists essentially in measuring the volume of the solution after the boiling point has been determined, instead of ascertaining its weight. This is effected by graduating the boiling tube, and permits of a number of successive experiments being made with the same quantity of substance. Only one weighing is necessary for the whole series, which occasions a considerable saving of time, making it possible to obtain four or five determinations in the course of half an hour. The accuracy is comparable with that of the Victor Meyer vapour density method in ordinary circumstances.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Goode, George Brown (Editor). The Smithsonian Institution, 1846—1896. The History of its First Half Century. City of Washington, 1897. Royal 8vo. Pp. x+856, with 26 full-page illustrations. Smithsonian Publication No. 1086.

Howe, Jas. Lewis. Bibliography of the Metals of the Platinum Group: Platinum, Palladium, Iridium, Rhodium, Osmium, Ruthenium. City of Washington, published by the Smithsonian Institution, 1897. 8vo. Pp. 318. From Smithsonian Miscellaneous Collections, 38, (No. 1084).

Copy of Jubilee Medal in bronze. From M. Carteighe, Esq.

Neumann, Bernhard. The theory and practice of Electrolytic Methods of Analysis, translated by J. B. C. Kershaw. Pp. x+254. London 1898. From the Publishers.

Bottone, S. R. Radiography and the X-rays in practice and theory with constructional and manipulatory details. Pp. x+176. London 1898. From the Publishers.

Obach, E. F. A. Cantor Lecture on Gutta Percha. Pp. 102. (Reprinted from the *Journal of the Society of Arts.*) London 1898. From the Author.

II. *By Purchase.*

Paracelsus. The hermetic and alchemical writings of Aureolus Philippus Theophrastus Bombast of Hohenheim, called Paracelsus, edited by A. E. Waite. 2 vols. 4to. Pp. xvi + 394 and viii + 396. London 1894.

The Hermetic Museum. The illustrations produced in facsimile. Containing translations of the following works.

The Golden Treatise concerning the Philosopher's Stone.
The Golden Age come back.
The Sophic Hydrolith, or Water Stone of the Wise.
The Demonstration of Nature.
A Philosophical Summary.
The Path of the only Truth.
The Glory of the World, or Table of Paradise.
The Generation of Metals.
The Book of Alze.
Figures and Emblems concerning the Philosopher's Stone.
The Practice and Keys of Basil Valentine.
The Ordinal of Alchemy.
The Testament of John Cremer, sometime Abbot of Westminster.

The New Light of Alchemy.
The Sulphur of the Philosophers.
An Open Entrance to the Closed Palace of the King.
A Subtle Allegory concerning the Secrets of Chemistry.
The Metamorphosis of Metals.
A Short Guide to the Celestial Ruby.
The Fount of Chemical Truth.
The Golden Calf.
The All-wise Doorkeeper.

2 vols. 4to. Pp. xi + 357: and 352. London 1893.

Collectanea Chemica, being certain select treatises on Alchemy and Hermetic Medicine, by Eirenæus Philalethes, Francis Anthony, George Starkey, Sir George Ripley, etc.

The Secret of the Immortal Liquor called Alkahest.
Aurum Potabile.
The Admirable Efficacy of the True Oil of Sulphur Vive.
The Stone of the Philosophers.
The Bosom Book of Sir George Ripley.
The Preparation of the Sophic Mercury.

8vo. Pp. 160. London 1893.

Benedictus Figulus. A Golden and Blessed Casket of Nature's Marvels. Concerning the blessed mystery of the Philosopher's Stone. 8vo. Pp. xxxi + 361. London 1893.

Janus Lacinius. The New Pearl of Great Price. A treatise concerning the treasure and most precious stone of the philosophers. Illustrated with symbolical designs. 8vo. Pp. xi + 441. London 1893.

Edward Kelley. The Englishman's two excellent treatises concerning the Philosopher's Stone, together with the Terrestrial Theatre of Astronomy. 8vo. Pp. lxvii + 153. London 1893.

Basilius Valentinus. The Triumphal Chariot of Antimony, with the commentary of Theodore Kerckringius. Engraved title and plates. 8vo. Pp. xxxiii + 204. London 1893.

Jones, H. C. The Freezing-Point, Boiling-Point, and Conductivity Methods. Pp. vii + 64. Easton, Pa., 1897.

Threlfall, Richard. On Laboratory Arts. Pp. xii + 338. London 1898.

Journal of the Royal Agricultural Society. Vols. I—XXV, 1st Series, with General Index, 1840—1864. Vols. I—XXV, 2nd Series, with General Index, 1865—1889. Vols. I—VI, 3rd Series, 1890—1895.

Pamphlets.

Liversidge, A. Abbreviated names for certain Crystal forms.
—— Models to show the Axes of Crystals.
—— Variation in the amount of free and albuminoid Ammonia in

Waters, on keeping; On the Corrosion of Aluminium.

—— Crystallised Carbon Dioxide; on the Internal Structure of Gold Nuggets; Contributions to the Bibliography of Gold; Experiments on the Waterproofing of Bricks and Sandstones with Oils; Experiments upon the Porosity of Plasters and Cements. (Reprinted from the *Transactions* of the Australasian Association for the Advancement of Science.)

—— On some New South Wales and other Minerals. Note No. 7.

—— On the Amount of Silver and Gold in Sea Water.

—— The Removal of Gold and Silver from Sea Water by Muntz Metal Sheathing. (Reprinted from the *Transactions* of the R.S.N.S.W.)

BANQUET TO PAST PRESIDENTS.

It has been arranged by the Council that the Society shall entertain at a Banquet at the Hôtel Métropole, on June 9th, the following Past Presidents who have completed a period of fifty years Fellowship of the Society:—Lord Playfair: Sir J. H. Gilbert: Sir E. Frankland: Prof. Odling: Sir F. A. Abel, Bart.: Dr. A. W. Williamson: Dr. J. H. Gladstone. The Secretaries will be glad to hear as soon as possible, and *in any case not later than May 14th*, from those Fellows who intend to be present, and also if they desire to bring guests (at present limited to two).

The price of tickets will be One Guinea each, including wine. They will be forwarded on receipt of a remittance for the number of tickets required, addressed to the Assistant Secretary, Chemical Society, Burlington House, W.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, accompanied by full particulars, should be sent to the Secretaries on or before June 6th.

At the next meeting, on Thursday, May 19th, the following papers will be communicated by the authors.

"The action of formaldehyde on amines of the naphthalene series." By G. T. Morgan, B.Sc.

"On the constitution of oleic acid and its derivatives. Part I." By F. G. Edmed, B.Sc.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 26/5/1898

PROCEEDINGS
OF THE
CHEMICAL SOCIETY.
EDITED BY THE SECRETARIES.

No. 195. Session 1897–8.

May 19th, 1898, Professor Dewar, F.R.S., President, in the Chair.

Messrs. T. M. Lowry, H. St. John, and J. Heaton were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. John Brighouse Buchan, 17, Steven Street, Stretford, Manchester; Charles William Tisdale Davies, Wye, Kent; Robert Findlay Hislop, Craigielea, Paisley; George Herbert Martin, New College, Eastbourne; Charles James Meads, Brooklynn, Erlanger Road, St. Catherine's Park, S.E.; Matthew Joseph Sheridan, 20, Heathland Road, Stoke Newington, N.

The following papers were read:—

79. "The liquefaction of hydrogen and helium." By James Dewar, LL.D., F.R.S.

In a paper entitled "The liquefaction of air and research at low temperatures (*Proc.*, 1895, 11, 221), an account was given of the history of the hydrogen problem and the result of the author's experiments to the end of the year 1895. The subject was again discussed in a lecture on "New researches on liquid air" (*Proc. Roy. Inst.*, 1896, 15, i, 144), and a sketch given of the apparatus employed for the production of a jet of hydrogen containing liquid. It was shown that such a jet could be used to cool substances below the temperature which could be reached by the use of liquid air, but all attempts to collect the liquid in vacuum vessels failed. The type of apparatus used in these experiments worked well, so it was resolved to construct a much larger liquid air plant, and to combine with it circuits and arrangements for the liquefaction of hydrogen. This apparatus, admirably constructed by the engineers,

Messrs. Lennox, Reynolds and Fyfe, took a year to build up, and many months were occupied in testing and making preliminary trials. The many failures and defeats need not be detailed.

On May 10th, hydrogen was liquefied by allowing the gas, cooled to $-205°$, and under a pressure of 180 atmospheres, to escape continuously at the rate of from 10 to 15 cubic feet per minute from the nozzle of a coil of pipe in a double silvered vacuum vessel of special construction surrounded with a space kept below $-200°$. Liquid hydrogen commenced to drop from this vacuum vessel into another doubly isolated by being surrounded with a third. On this occasion, 20 c.c. of liquid hydrogen were collected in about five minutes, and on May 12th 50 c.c. were obtained before the hydrogen jet froze up from the solidification of air in the pipes. The yield of liquid was about 1 per cent. of the gas. The hydrogen in the liquid condition is clear and colourless, showing no absorption spectrum and the meniscus is as well defined as in the case of liquid air. The liquid must have a relatively high refractive index and dispersion, and the density appears to be in excess of the theoretical value, 0·18 to 0·12, deduced respectively from the atomic volume of organic compounds and from the limiting density found by Amagat for hydrogen gas under infinite compression. The author's experiments on the density of hydrogen in palladium gave a value 0·62 for the substance in combination, and it will be interesting to find the density of the actual liquid at its boiling point. Not having arrangements at hand to determine the boiling point, two experiments were made to prove the excessively low temperature of the boiling fluid. In the first place, a long piece of glass tubing, sealed at one end, but open to the air at the other, and cooled by immersing the closed end in liquid hydrogen, immediately filled, where it was cooled, with solid air. The second experiment was made with a tube containing helium.

The Bulletin of the Cracow Academy for 1896 contains a paper by Professor Olszewski, entitled "A research on the liquefaction of helium," in which he states that "as far as my experiments go, helium remains a permanent gas and apparently is much more difficult to liquefy than hydrogen." Helium which had been extracted from Bath gas by the liquefaction method described last year (*Proc.*, 1897, 13, 190) and sealed up in a bulb with a narrow tube attached, was placed in liquid hydrogen, and a distinct liquid was seen to condense. A similar experiment made with the same helium tube in liquid air under exhaustion instead of in liquid hydrogen gave no visible condensation. It would thus appear, as already suggested by the author (*loc. cit.*), that there cannot be any great difference in the boiling points of helium and hydrogen. A fuller account of the work will appear in the *Transactions*.

All known gases have now been condensed into liquids which can be manipulated at their boiling points under atmospheric pressure in suitably arranged vacuum vessels. With hydrogen as a cooling agent, it will be possible to get within 20° or 30° of the zero of absolute temperature, and its use will open up an entirely new field of scientific inquiry.

During the whole course of the low temperature work carried out at the Royal Institution, the invaluable aid of Mr. Robert Lennox has been at the author's disposal, and it is not too much to say that, but for his engineering skill, manipulative ability, and loyal perseverance, the present successful issue might have been indefinitely delayed. The author's thanks are also due to Mr. J. W. Heath for valuable assistance in the conduct of these experiments.

Discussion.

Sir William Crookes proposed that the Fellows of the Society should offer their best congratulations to the President on the striking success which had attended his remarkable attempts to liquefy the last of the 'permanent' gases—hydrogen and helium.

Dr. Armstrong, in seconding the proposal, said that in the future the fact that the liquefaction of hydrogen had been achieved by a President of the Society would no doubt be recalled with interest. In early days, the discussion of the properties of hydrogen had attracted much attention in the Society when Sir Benjamin Brodie advocated the view that it must be supposed to have metallic properties, a view subsequently strongly supported by Graham's discovery of hydrogenised palladium. He ventured to think, however, that the subject had been regarded too much from the inorganic side, and that when the evidence to be derived from organic chemistry was taken into account, it was more probable that hydrogen would be found to resemble the petroleum hydrocarbons rather than the metals.

He then asked whether the President's statement that argon solidified when cooled in liquid air did not preclude the presence of argon in the helium from Bath gas, which gave only a liquid when cooled in hydrogen.

The motion was carried by acclamation.

The President, in acknowledging the compliment, said that the facts referred to by Dr. Armstrong proved that the helium employed in the liquefaction experiments did not contain argon. It was possible that hydrogen might be present in small quantity, but otherwise the helium was pure.

80. "The action of formaldehyde on amines of the naphthalene series. Part I." By Gilbert T. Morgan, B.Sc.

By the interaction of methylal, acetone, and β-naphthylamine, Reed (*J. prakt. Chem.*, 1887, **35**, 314) obtained naphthacridine, $C_{21}H_{13}N$ (m. p. 216°), and a substance melting at 202—203°, to which he gave the formula $C_{24}H_{20}N_2$.

The author finds that when formaldehyde (40 per cent. solution) acts on β-naphthylamine in alcoholic solution in the presence of hydrochloric acid, four basic substances are produced. Two of these have the composition corresponding with the formula $C_{21}H_{13}N$; one crystallises in orange needles melting at 225—226°, and the other in straw coloured needles melting at 216°. The latter was found to be identical with naphthacridine.

The third substance crystallises in colourless prisms often showing cruciform twinning, melts at 203°, and is identical with the compound of this melting point described by Reed. Its composition is expressed by the formula $C_{23}H_{18}N_2$, and as the author has obtained it by the action of formaldehyde alone on β-naphthylamine, it follows that acetone plays no part in the condensation.

The fourth compound is obtained only in small quantity, crystallises in silky needles having a faintly yellow tinge, melts at 186—187°, and has the formula $C_{22}H_{16}N_2$. Its *hydrochloride*, $C_{22}H_{16}N_2,HCl$, and *nitrite*, $C_{22}H_{16}N_2,HNO_2$, have been prepared, and the base can be regenerated from either salt by means of aqueous alkalis.

The orange coloured base melting at 225—226° stands in very close relationship to the isomeric naphthacridine (m. p. 216°), and is converted into it both easily and quantitatively. Its behaviour with hydrogen chloride is remarkable. When it is triturated with concentrated hydrochloric acid or submitted to the action of the dry gas, it forms a green hydrochloride, from which the orange base is obtained; but when dry hydrogen chloride is passed into its solution in benzene or in glacial acetic acid a yellow hydrochloride is produced, which yields naphthacridine (m. p. 216°). The orange base is probably a labile form of naphthacridine. Methods for preparing each form in quantity are given in the paper, and the *hydriodide*, *methiodide*, and *ethiodide* of naphthacridine (m. p. 216°) are described.

The products of the interaction between formaldehyde and α-naphthylamine have been examined with results which will be communicated in a subsequent paper, and the investigation is being extended to derivatives of both α- and β-naphthylamine.

Discussion.

Professor Dunstan pointed out that commercial formalin usually contains acetone, so that, unless the author had satisfied himself of the purity of the formaldehyde, the fact that the interaction of the commercial solution and β-naphthylamine gave rise to the condensation product did not necessarily tell in favour of the view that acetone was not concerned in the action.

Mr. Morgan, in reply, said that the formaldehyde solution employed could have contained only a small amount of acetone. The base melting at 203° is readily reduced to naphthacridine by means of hydriodic acid and phosphorus, and this fact not only supports the formula adopted by the author, but also—taken in conjunction with the large yield of the base when prepared from β-naphthylamine and formaldehyde—makes it improbable that acetone takes any part in the condensation.

81. "On the constitution of oleic acid and its derivatives. Part I." By Frank George Edmed, B.Sc.

Oleic and elaidic acids, when oxidised by weak alkaline permanganate, yield two dihydroxystearic acids, melting respectively at 134° and 99° (Saytzeff, *J. Russ. Chem. Soc.*, 1885, 17, 417). The author finds that, while these acids are the chief products of the reaction, pelargonic, azelaic, and oxalic acids are also formed at the same time. These acids result from the continued action of the oxidising agent on the dihydroxystearic acids, and no evidence could be obtained of the formation of sebacic, suberic, and caprylic acids, which, with azelaic acid, have been stated to be the products of the further action of permanganate (Spiridonoff, *J. Russ. Chem. Soc.*, 1887, 19, 646). The dihydroxystearic acid obtained from elaidic acid is much more easily oxidised than its isomeride, a fact which is consistent with the stereoisomeric formula ascribed to elaidic acid. The formation of pelargonic and azelaic acids affords additional evidence in support of the formula, $CH_3(CH_2)_7CH{:}CH(CH_2)_7CO_2H$, for both oleic and elaidic acids.

Oleic acid was also oxidised with a weak solution of chromic acid; the action was very slow, and a considerable quantity of azelaic acid, but only a trace of pelargonic acid, was obtained. No other products could be isolated, and the action appears to be similar to that of the permanganate.

The products resulting from the fusion of oleic and of elaidic acids with potash were quantitatively examined, and it was found in both cases that the yield of palmitic acid was approximately theoretical, but that the quantity of acetic acid was extremely small. Oxalic acid was

also produced in the reaction, and the amount exceeded that of the acetic acid, but neither pelargonic nor azelaic acids could be detected, nor could any dihydroxystearic acid be recognised, although from Wagner's explanation of the reaction (*Ber.*, 1888, **21**, 3353), this might be expected to be an intermediate product.

Discussion.

Mr. Hehner was by no means convinced that the double linkage occurred between the central carbon atoms in the oleic acid formula. No doubt oleic acid on oxidation formed azelaic acid by preference, but as by other means, for instance, by treatment with sulphuric acid or zinc chloride, lactones were very readily obtained, it seemed possible that oleic acid was a labile compound, and that the double linkage had not a definite position in the molecule. He was astonished at the excellent yield of dihydroxystearic acid obtained by the author by means of alkaline permanganate; in the most favourable circumstances, he had been able to obtain only about 40 per cent. of the theoretical yield, and this, he thought, was also the experience of other workers. The oxidation by means of chromic acid might have succeeded better if a solution of chromic anhydride in acetic acid had been employed, instead of a mixture of bichromate and sulphuric acid. As to the deficiency in the yield of acetic acid in the potash fusion, might not some of the acetate have decomposed into methane?

The question arose whether oleic acid could be regarded as a single substance. The number of isomerides possible in the case of compounds containing eighteen carbon atoms was enormous, and, while many were well known among the lower members of the series, it was remarkable that when a chain of about ten carbon atoms was reached, all reference to isomerides disappeared from the text-books, solely, in his opinion, because means for their separation had not been devised. At the same time, indications existed, such as slight differences in the optical behaviour of oils of a similar degree of unsaturation, and in the solidifying points of the fatty acids separated from them, which pointed towards isomerism. It was essential to elucidate this point before studying the constitution of the substance called oleic acid, especially as most of the work which had been done was antecedent to the recognition of the existence of less saturated acids, such as linolic and linolenic acids and their homologues, which were almost invariably present with acids of the oleic class.

Dr. Crossley was surprised to learn that a nearly theoretical yield of dihydroxystearic acid was obtained by oxidising oleic acid with permanganate, as in similar experiments he had never succeeded in obtaining more than 40 per cent. of the amount theoretically possible.

Referring to Wagner's explanation of the production of palmitic from oleic acid by fusion with potash, he pointed out that it received support from many cases in which this alkali seems to act simultaneously as an oxidising and reducing agent, and suggested that the fusion of oleic acid with soda might lead to interesting results, as caustic soda apparently does not exercise a reducing action.

Professor TILDEN said that, in his opinion, a body of evidence had been brought forward which amounted almost to positive proof of the correctness of the symmetrical formula for oleic acid. And, referring to the remarks of Mr. Hehner, he would venture to say that if it came to a question of the credibility of evidence, he should distinctly prefer the testimony derived from the action of a 1 or 2 per cent. solution of permanganate in the cold to that of such agents as zinc chloride or caustic potash, which required a high temperature.

Professor DUNSTAN doubted whether there was any real evidence that crystallisable oleic acid obtained from different oils is not a single substance. He thought it more probable that the differences Mr. Hehner had alluded to were due to impurities occurring in the natural oils.

Mr. EDMED, in reply, said that the quantitative yield of palmitic acid in the potash fusion precluded the supposition that the oleic acid employed contained a branched-chain isomeride. It was not possible to accept Mr. Hehner's suggestion that the small amount of acetic acid obtained was due to a decomposition of potassium acetate into methane during the reaction, as the temperature was not allowed to exceed 230° during the fusion.

82. "Stereoisomeric derivatives of camphor." By T. M. Lowry, B.Sc.

In addition to the case of stereoisomerism referred to in a previous note (*Proc.*, 1897, 13, 159), the author has investigated that of the dibromochlorocamphors, $C_8H_{13}Br\langle^{CClBr}_{CO}\rangle$, obtained by heating chlorocamphor with an excess of bromine in sealed tubes. When recrystallised five times, the product melted at 81° and had a specific rotatory power $[\alpha]_D = 44{\cdot}5°$ in a 5 per cent. solution in chloroform; after five more crystallisations, the rotatory power was raised to 51·3°, but no increase was observed after sixteen further crystallisations. The melting point also was constant at 84°. There can be no doubt that the change in rotatory power indicates the presence of two stereoisomerides, and the product must, therefore, be an isomorphous mixture similar to that afforded by the bromochlorocamphors previously described, from which it differs only by the presence of an additional bromine atom in the β-position.

BANQUET TO PAST PRESIDENTS.

Fellows who have announced their intention of being present at the Banquet on June 9th are requested to send to the Assistant Secretary, Chemical Society, Burlington House, W., remittances for the number of tickets required *without delay*, in order that the tickets may be forwarded to them. The names of guests should also be notified.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, accompanied by full particulars, should be sent to the Secretaries on or before June 6th.

At the next meeting, on Thursday, June 2nd, the following paper will be communicated by the authors.

"On the behaviour of certain organic substances towards hydrogen bromide in presence of ether." By Henry J. Horstman Fenton, M.A., and Mildred Gostling, B.Sc.

CERTIFICATES OF CANDIDATES FOR ELECTION.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, June 16th.

Brearley, Harry,

Totley, Derbyshire, via Sheffield.

Metallurgical Chemist at Messrs. Thos. Firth & Sons, Ltd. S. K. certificates in Mathematics (IV.), General Physics and Mechanics (adv.); subsequently two years Math. and Phys. at Firth College, also Chem. and Phys. Laboratory course. Metallurgical training in lab. Thos. Firth & Sons, Sheffield, under J. Taylor, B.Sc., A.R.S.M., &c.; last five years chief assistant. Author of "Estimation Mn in Spiegels," *C.N.*, 75, 13; "Carbon in Ferrochromium," *C.N.*, 75, 241; "Separations with Alkaline Acetates" *C.N.*, 75 and 76; "Cyanide Estimations of Copper," *C.N.*, 76, 189, 291, 303, "Separations from Chromic Acid," *C.N.*, 77.

R. Leffler. William Crookes.
George Young. Fred. Ibbotson.
Fredk. J. Merrils.

Buchan, John Brighouse,

17, Steven Street, Stretford, Manchester.

Managing Partner of The Anchor Chemical Engineering Co., Stretford, Manchester. Laboratory Assistant at the Clayton Aniline Co.'s works, Manchester (3 years). Laboratory assistant and undermanager at Messrs. Brunner, Mond & Co.'s works, Northwich (6 years). Manager of Experimental Plant at Messrs. Peter Spence & Son's works, Manchester (1 year). Manager of Messrs. Adley, Tolkien & Co.'s works, Blackburn (9 months). Left Blackburn to take up present position.

Daniel Bray. R. L. Taylor.
Charles Crocker. *S. W. Harris.*
Clarence A. Seyler.

Cowburn, Arthur William,
"Fernroyd," Bowdon, Cheshire.

Chemist. Student of Chemistry between 1892 and 1895 at the Technical School Manchester. Between 1894 and 1896 at Owens College, and pupil to Messrs. Crace, Calvert and Thomson, Royal Institution Laboratory of Manchester, since 1896.

William Thomson.	H. B. Dixon.
J. Carter Bell.	Harry Grimshaw.
Jas. Grant.	James Porter Shenton.

W. H. Perkin, junr.

Davies, Charles William Tisdale,
Wye, Kent.

Student at the South-Eastern Agricultural College. Holder of Diploma and Silver Medal of British Dairy Farmers' Association for Science and Practice of Dairy Farming and Dairying, also Diploma of South Eastern Agricultural College for Scientific and Practical Agriculture. For 4 years Student of Chemistry, the latter 3 years being spent at the South-Eastern Agricultural College, Wye, Kent. Desirous of Fellowship of the Society whereby to obtain further knowledge (by means of its publications, &c.) of Chemistry, both Analytical and especially as applied to Agriculture and Dairying.

John Percival.	H. J. Monson.
Edward G. Guest.	*John M. Thomson.*
A. D. Hall.	*H. Brereton Baker.*

Dowzard, Edwin,
30, The Willows, Liverpool.

Analytical Chemist. Three years as apprentice and assistant with the firm of Messrs. A. N. Tate & Co., Analytical Chemists, Liverpool. During the past 3 years analyst to Messrs. Evans, Sons & Co., Liverpool. Author of the following, "A Quick Polarimetric Method for the Estimation of Starch in Flour," *Chem. News*, 77, 107.

Francis Henry Tate.	F. Harwood Lescher.
Edward Davies.	*Francis Vacher.*

J. Campbell Brown.

Foulerton, Alexander Grant Russell,
Dunsdale, Mulgrave Road, Sutton, Surrey.

Fellow of the Royal College of Surgeons, England. Assistant Bacteriologist, British Institute of Preventive Medicine. Engaged in investigations of Physiological Chemistry; formerly Demonstrator of Biological Chemistry, British Institute of Preventive Medicine.

Henry E. Roscoe.	Chas. Slater.
Arthur Harden.	Samuel Rideal.

Christopher Childs.

Hamilton, Oswald,

Old Stratford, Stony Stratford.

Chemical Engineer. Five years private assistant Owens College, Manchester. Two years private assistant University College, London, during which time assisted in the editing of *Journal of Society of Chemical Industry* and other scientific literature. Manager of the British White Lead Co., Ltd., 5 years, having designed and constructed plant and process. Researches on Blast Furnace products, lead compounds, and many others.

Watson Smith. William Ramsay.
B. E. R. Newlands. Henry E. Roscoe.
John A. R. Newlands.

Hemmy, Arthur Stanley, B.A., M.Sc.,

Government College, Lahore, India.

Professor of Physical Science. Formerly Assistant Professor of Chemistry, Heriot-Watt College, Edin. Joint author with Dr. S. Ruhemann of papers on Organic Chemistry.

S. Ruhemann. M. M. Pattison Muir.
A. Sheridan Lea. R. S. Morrell.
R. H. Adie. Sidney Skinner.

Hislop, Robert Findlay,

Craigielea, Paisley.

Assistant Gas Engineer and Chemist, Gas Works, Paisley. Studied Chemistry for the past 10 years under Professor Ferguson, of Glasgow University, the late Professor Dittmar, of the Andersonian College, Glasgow, and under Messrs. R. R. Tatlock and Reedman, City Analysts, Glasgow, and for the past 5 years have acted as chemist, &c., at the Paisley Gasworks. Have considerable experience in analysis of Coals and Coke for gas, steam, domestic, and metallurgical purposes.

Geo. R. Hislop. R. R. Tatlock.
James Robson. Thomas Gray.
G. G. Henderson. *Matthew A. Parker.*

Jarvis, George Arthur,

The Shrubbery, Snedshill, Wellington, Salop.

Analytical and metallurgical chemist. Over 22 years' experience as analytical chemist. Technical Education lecturer. Three and a half years with Edward Riley, F.I.C., F.C.S. Assistant chemist Wigan Coal and Iron Co., Ltd. Chemist to West Yorkshire Iron and Coal Co., Ltd. Three and a half years chemist New Russia Co., Ltd.

Assistant to late Sidney Gilchrist Thomas. 13 years chemist to The Lilleshall Co., Ltd.

Edwd. Riley. Percy Elford.
F. W. Hart. Geo. P. Rees.
Wm. P. Thompson.

Lee, Harry Lancelot,

8, Chichester Street, St. George's Square, London, S.W.

Lecture Assistant in the School of the Pharmaceutical Society. Studied Chemistry for three years in the Pharmaceutical Society's School. Student Session 1894—5. Lecture Assistant to Prof. Dunstan, Session 1896. Lecture Assistant to Prof. Collie, Sessions 1896—7, 1897—8.

John Norman Collie. Wyndham R. Dunstan.
Ernest Goulding. Arthur Lapworth.
Thomas Tickle.

Lewins, William,

43, Exeter Street, Gateshead.

Science Teacher, Organised Science School, Gateshead. Bachelor of Science, London University. Lecturer in Chemistry in the above School for five years.

P. Phillips Bedson. Saville Shaw.
F. C. Garrett. R. Greig Smith.
J. G. Taylor.

Martin, George Herbert,

New College, Eastbourne.

Science Master. Late Science Postmaster of Merton College, Oxford. B.A. 1st Class in Final Honour School of Natural Science. Formerly Science Master at (i) Clergy Orphan School, Canterbury, (ii) Wellington College, Berks. At present Science Master at New College, Eastbourne. Assisted Dr. Rideal in the investigation of the chemical actions which take place in the Septic Tank System of Sewage treatment.

W. W. Fisher. Samuel Rideal.
John Watts. J. E. Marsh.
V. H. Veley. William Esson.

Meads, Charles James,

Brooklynn, Erlanger Road, St. Catherine's Park, S.E.

Chemist. Two years Student at Royal College of Science (1894—6). Two years Assistant in Government Laboratory (1896—8). Two years Demonstrator, Birkbeck Institution (1896—8).

T. E. Thorpe. H. J. Helm.
E. Grant Hooper. J. Woodward.
William A. Tilden. John E. Mackenzie.

Nash, Leonard Myddleton,

281, Seven Sisters' Road, Finsbury Park, N.

Chemist to Colour Works. Studied Chemistry and Metallurgy in King's College, London, from 1895—1898. Passed the Intermediate Examination of the Institute of Chemistry, 1898. Also worked with Mr. Bertram Blount. Became M.S.C.I. in 1897.

John M. Thomson. Bertram Blount.
Herbert McLeod. Herbert Jackson.
Patrick H. Kirkaldy. A. K. Huntington.
William H. Sodeau.

Neilson, Alexander MacGillivray

c/o Messrs. T. Stanes & Co., Coimbatore, Madras, India.

Analytical Chemist. Four years with Messrs. McCowan and Biggart, Public Analysts, Greenock. Six years with Messrs. Alex. Cross and Sons, Limited, at Port Dundas Chemical Works, Glasgow. Now Chemist to Messrs. T. Stanes and Co., Coimbatore, India. Have studied Chemistry and other sciences at Holmscroft Science School, Greenock, the Technical College, and the University of Glasgow.

John Wm. Biggart. John Peden, jun.
Alexander M. Forrester. James Robson.
Angus Smith. *Matthew A. Parker.*
Thomas Gray.

Russell, Edward John,

The Owens College, Manchester.

Demonstrator in Chemistry in the Owens College. Two years in the Laboratories Univ. Coll., Aberystwyth. One year in the Laboratories, Owens College. B.Sc. 1st Class Honours Chemistry, London Univ., 1896. For two years private assistant to Prof. H. B. Dixon. Joint author of paper "On the Explosion of Chlorine Peroxide with Carbonic Oxide," *Journ. Chem. Soc.*, 1896.

Harold B. Dixon. J. F. Thorpe.
W. H. Perkin, jun. A. William Gilbody.
P. J. Hartog.

Sheridan, Matthew Joseph,

20, Heathland Road, Stoke Newington, N.

Member of Her Majesty's Civil Service. For 10 years Senior Assistant Analyst in the Laboratory of H.M. Customs; two years in Finsbury Technical College under Prof. Meldola; and at present at the Royal College of Science, London.

T. E. Thorpe. William A. Tilden.
W. Palmer Wynne M. O. Forster.
G. T. Morgan.

Stein, Sigmund,

323, Vauxhall Road, Liverpool.

Chemist and Manager of the Sugar Refinery of Messrs. Crosfield, Barrow and Co., Liverpool. Student of the Vienna Polytechnicum and University for five years; Chemist in various Continental Sugar Works and Distilleries; seven years with Messrs. Crosfield, Barrow and Co.

George Tate. — Francis Henry Tate.
Thomas J. Roberts. — *Joseph T. Freestone.*
Edward Davies.

Steinhart, Oscar Julian,

4, Palace Street Mansions, London, S.W.

Technical Chemist. Ph.D., University of Erlangen (Bavaria). Dissert., "Über einige Anisylamine." Five years' study Polytechnicum and Universities of Munich and Erlangen. Two and a half years Managing Chemist to May and Baker, Limited, London, S.W. Three years Chemist to Chemical and Electrolytical Syndicate, Offices, 6 Clement's Lane, E.C.

William Crookes. — Herbert Jackson.
John M. Thomson. — B. E. R. Newlands.
F. Maxwell Lyte. — R. H. Harland.
John A. R. Newlands.

Tucker, Samuel Auchmuty,

Columbia University, New York.

Tutor in Industrial Chemistry. Graduate of Columbia College School of Mines, 1895, receiving degree Ph.B., Course of Analytical and Applied Chemistry. For 2 years as Assistant in Toxicology and Assistant Demonstrator of Chemistry and Physics, College of Physicians and Surgeons, New York. Present position, Tutor, Industrial Chemistry, Columbia University, New York.

C. F. Chandler. — Elwyn Waller.
H. T. Vulté. — Fredc. H. Bowman.
Jas. S. C. Wells. — *Arthur H. Elliott.*

Waller, Henry Trench,

Zeehan, Tasmania.

Instructor in Analytical Chemistry and Assaying to the Zeehan School of Mines. Royal College of Science, London, 18 months as Student, passing in Inorganic and Analytical Chemistry; Physics, Part I.; Mechanics, Part I.; Astronomical Physics. Government Analysts' Office, Hobart, 9 months as Student. School of Mines, Ballarat, Victoria, 12 months as Student, passing in Analytical

Chemistry, Grades I., II., and III.; Theoretical Chemistry, Grade III.; Metallurgy, Grade I.; Assaying, Grade I. Zeehan School of Mines, Tasmania, Instructor in Analytical Chemistry and Assaying 12 months.

H. Droop Richmond. W. Palmer Wynne.
T. E. Thorpe. Basil Turner.
A. J. Bensusan.

Weston, Frank Edwin,
43, Larkhall Rise, Clapham, S.W.

Teacher of Chemistry at the Polytechnic Institute, Regent Street, W. Teacher of Chemistry since November, 1893, in the Day Classes and Evening Classes of the above Institution. Passed Inter. Sci., London University (Honours in Chemistry), 1891.

Charles E. Browne. Geo. Stubbs.
Frank Gossling. J. Woodward.
C. H. Burge. *J. H. Robbins.*
E. Grant Hooper.

Whitaker, Edmund Thomas,
Swan Hill Court, Shrewsbury.

Medical Officer of Health. M.B., C.M., B.Sc. (Edin.). D.P.H., Cambridge. Fellow of Society of Medical Officers of Health, Member of Hon. Soc. of Inner Temple, Member of Sanitary Institute, &c.

Douglas Maclagan. W. Ivison Macadam.
Thos. P. Blunt. Walter D. Severn.
S. Arch. Vasey.

Wild, William Ernest,
230, Turton Road, Bromley Cross, nr. Bolton.

Analytical and Consulting Chemist. Graduate (B.Sc.), in Chemistry, of Victoria University. Assistant for three years to Messrs. Crace, Calvert and Thomson, Analytical and Consulting Chemists, of Manchester, and at present Chemist to Messrs. James Hardcastle & Co., Bleachers, Dyers, Calico Printers and Finishers, with which firm I have been connected 4½ years.

William Thomson Henry E. Roscoe.
H. B. Dixon. *D. T. Lawrence.*
A. William Gilbody.

Williamson, William,
86, Tyndall Road, Leyton, E.

Analyst in the Laboratory of H.M. Customs. Studied Chemistry at Gordon's College, Aberdeen, and at the Heriot-Watt College,

Edinburgh. Studied for two years at the Royal College of Science under Professor Tilden.

T. E. Thorpe. William A. Tilden.
W. Palmer Wynne. M. O. Forster.
G. T. Morgan.

Witham, Ernest,
The Grammar School, Rotherham.

Schoolmaster. Science Master at the Rotherham Grammar School for six years. Engaged during spare time in research in Chemistry at University College, Sheffield.

W. Carleton Williams. George Young.
L. T. O'Shea. Fred Ibbotson.
William H. Oates.

Wrench, Charles Arthur,
3, Parklands, Surbiton Hill.

Assistant Chemist to Messrs Stevenson and Howell, 95A, Southwark Street, S.E. For sixteen months with Messrs. Helbing and Passmore Analytical Chemists, and for four years with Messrs Stevenson and Howell, Manufacturing Chemists, 95A, Southwark Street, London, S.E.

H. Helbing. William Stevenson.
Reginald Howell. E. Russell Budden.
John Heron. *Wyndham R. Dunstan.*
Chas. Geo. Matthews. *Adrian J. Brown.*

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 8/6/1898.

PROCEEDINGS
OF THE
CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 196. Session 1897–8.

June 2nd, 1898, Professor Dewar, F.R.S., President, in the Chair.

Messrs. A. L. H. Garside and K. J. P. Orton were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Walter Birkett, 23 Cheviot Street, Lincoln; Alfred Hartridge, 14 Broad Street, Oxford; Charles William Tuthill Woods, St. Kilda, Tudor Road, Upper Norwood.

THE DEATH OF LORD PLAYFAIR.

The PRESIDENT said that the melancholy duty devolved on him to announce the death of the Right Hon. Lord Playfair, P.C., G.C.B., LL.D., F.R.S., the senior Past President and last surviving Founder of the Society, which took place on Sunday, May 29th. It was needless for him to dwell on Lord Playfair's scientific standing, or well recognised position in public life; he would only refer to the fact that he was the creator of a new type of public servant, and his services to education and as a member of Royal and Departmental Commissions on subjects connected with the public welfare were so unquestioned that it would be well for the country if there were more such men. Lord Playfair was ever ready to acknowledge his indebtedness to Liebig, Graham, and his other teachers, and proud to attribute his successful career to his early training in scientific method as a chemist. The Society would be represented at the funeral at St. Andrews by a former President, Professor Crum Brown, F.R.S.

In consequence of the death of Lord Playfair, the Banquet to the Past Presidents, arranged for June 9th, had been postponed until Friday, October 28th.

The following papers were read :—

83. "The boiling point and density of liquid hydrogen." By James Dewar, LL.D., F.R.S.

The boiling point of liquid hydrogen at atmospheric pressure has been determined by a platinum resistance thermometer. This was constructed of pure metal and had a resistance of 5·3 ohms at 0° C., which fell to about 0·1 ohm when the thermometer was immersed in liquid hydrogen. On reduction of this resistance to normal air temperatures, the boiling point is found to be −238·2° and −238·9° respectively by two methods, and to be −237° by a Dickson formula calculated for this thermometer (*cf. Phil. Mag.*, 1898, **45**, 525). The boiling point of the liquid is, therefore, about −238° C or 35° absolute, and is thus about 5° higher than that obtained by Olszewski by the adiabatic expansion of the compressed gas, and about 8° higher than that deduced by Wroblewski from van der Waals' equation. It may be inferred that the critical point of hydrogen is about 50° absolute, and that the critical pressure will probably not exceed 15 atmospheres. As molecular latent heats are proportional to absolute boiling points, the latent heat of liquid hydrogen will be about two-fifths that of liquid oxygen. From analogy, it is probable that the practicable lowering of temperature to be obtained by evaporating liquid hydrogen under pressures of a few mm. cannot amount to more than 10—12° C., and it may be said with certainty that no means are at present known for approaching nearer than 20—25° to the absolute zero of temperature. The platinum resistance thermometer used had a zero point of −263·2 platinum degrees, and when immersed in boiling liquid hydrogen, indicated a temperature of −256·8° on the same scale, or 6·4 platinum degrees from the point at which the metal would become a perfect conductor. The effect of cooling platinum from the boiling point of liquid oxygen to that of liquid hydrogen is to diminish its resistance to one-eleventh.

The approximate density of liquid hydrogen at its boiling point was determined by measuring the volume of the gas obtained by evaporating 10 c.c., and is slightly less than 0·07, or about one-sixth that of liquid marsh gas, which has a density of 0·41 and is the lightest liquid at its boiling point hitherto known. It is remarkable that, with so low a density, liquid hydrogen is so easily seen, has so well defined a meniscus, and can be so readily collected and manipulated in vacuum vessels. As hydrogen occluded in palladium has a density of 0·62, it follows that it must be associated with the metal in some other state than that of liquefaction. The atomic volume of liquid hydrogen at the boiling point is about 14·3, the atomic volumes of liquid oxygen and nitrogen being 13·7 and 16·6 respectively at their boiling points.

The density of the gas at the boiling point of liquid hydrogen is 0·55, or about one-half that of air, and is eight times that of the gas at ordinary temperatures. The ratio of the density of hydrogen gas at the boiling point to that of the liquid is approximately 1 : 100, as compared with a ratio of 1 : 255 in the case of oxygen.

The specific heat of hydrogen in the gaseous state and in hydrogenised palladium is 3·4, but may very probably be 6·4 in the liquid substance. Such a liquid would be unique in its properties, but as the volume of one gram of liquid hydrogen is about 14—15 c.c., the specific heat per unit volume must be nearly 0·5, which is about that of liquid air. It is highly probable, therefore that the remarkable properties of liquid hydrogen predicted by theory will prove to be susceptible of explanation when they are compared with those of liquid air, volume for volume, at corresponding temperatures as defined by van der Waals.

84. **"The action of hydrogen bromide in presence of ether on carbohydrates and certain organic acids." By Henry J. Horstman Fenton, M.A., and Mildred Gostling, B.Sc.**

It has been previously shown by one of the authors (*Trans.*, 1896, 67, 553) that ethylic dihydroxymaleate can be readily produced by the interaction of the acid with anhydrous ether in presence of hydrogen bromide. This behaviour of ether as a "base" being unusual, at any rate, towards organic acids, it was considered desirable to make experiments with other acids in a similar manner; the results indicate that the reaction is a general one, and that the yields are satisfactory.

The study of the behaviour of ether and hydrogen bromide is now being extended to substances other than acids, and an account is given of the results obtained with carbohydrates and allied polyhydric alcohols. Certain of these substances develop an intense purple coloration, and it is found that the presence of ether, although advantageous, is not essential for its production. The coloured substance seems to resemble the compound described by Stenhouse and others as 'metafurfurol.' So far as the investigation has proceeded, ketohexoses and carbohydrates such as inulin which yield them on hydrolysis give an intense purple coloration in the course of an hour or two, aldohexoses give a purple coloration of comparatively moderate intensity in the course of a day or two, and other carbohydrates such as arabinose, rhamnose, starch, and cellulose, and alcohols such as mannitol, dulcitol and glycerol, give a brown, red, or yellow coloration free from any shade of purple. The only exception to this classification yet met with is xylose, which, although in the purest state obtainable, behaves similarly to the ketohexoses.

DISCUSSION.

Mr. CHAPMAN asked whether the authors had made any experiments with hydrogen chloride. Bouillon-Lagrange and Vogel (*Annales de Chimie*, 1809, 71, 91) had stated that both cane-sugar and milk-sugar absorb hydrogen chloride forming coloured products, which evolve the gas with effervescence on treatment with sulphuric acid.

Mr. FENTON, in reply, said that hydrogen chloride gives only a slight red colour, even after long standing, and that hydrogen iodide acts as a reducing agent liberating iodine.

85. "Production of some chloropyridinecarboxylic acids." By J. N. Collie, Ph.D., F.R.S., and W. Lean.

The authors have prepared from ethylic chlorolutidinecarboxylate (*Trans.*, 1897, 71, 303) several chloropyridinecarboxylic acids and, by reducing one of them with tin and hydrochloric acid, carbocinchomeronic acid, which is also one of the products of the action of oxidising agents on quinine and several other alkaloids.

Ethylic chlorolutidinemonocarboxylate was prepared by the action of phosphorus pentachloride on ethylic oxylutidinecarboxylate. It is a sweet smelling liquid boiling at 288—290°. *Chlorolutidinecarboxylic acid* can be obtained by hydrolysis of the ethylic salt; it crystallises in small needles melting at 148°. By the action of potassium permanganate on the ethylic salt, two acids were obtained, one having the formula $C_5HN(CO_2H)_2(CO_2Et)Cl$, $(\alpha\gamma : \beta : \alpha')$ and melting at 169°, the second being an *α'-chloropyridine-αβγ-tricarboxylic acid*, $C_5HN(CO_2H)_3Cl$, melting at 212°. The latter acid yielded carbocinchomeronic or pyridine-$\alpha\beta\gamma$-tricarboxylic acid, $C_5H_2N(CO_2H)_3$, when reduced with tin and hydrochloric acid.

At the next meeting, on June 16th, there will be a ballot for the election of Fellows, and the following papers will be communicated by the authors.

"Preparation of a standard acid solution by direct absorption of hydrogen chloride." By G. T. Moody, D.Sc.

"Researches on the terpenes. III. Halogen derivatives of fenchene and their reactions." By J. A. Gardner, M.A., and G. B. Cockburn, B.A.

"Researches on the terpenes. IV. On the oxidation of fenchone." By J. A. Gardner, M.A., and G. B. Cockburn, B.A.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 23/6/1898

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 197. Session 1897–8.

June 16th, 1898, Professor Dewar, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. Edward Gardner, 27 Thurlow Road, Hampstead, N.W.; Henry J. S. Sand, 2 Cantlowes Road, Camden Square, N.W.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected.

Harry Brearley; Arthur William Cowburn; Charles W. Tisdale Davies; Edwin Dowzard; A. Grant Russell Foulerton; Oswald Hamilton; A. Stanley Hemmy, B.A., M.Sc.; Robert Findlay Hislop; George Arthur Jarvis; Harry Lancelot Lee; William Lewins, B.Sc.; George Herbert Martin, B.A.; Charles James Meads; Leonard Myddleton Nash; Alex. MacGillivray Neilson; Edward John Russell, B.Sc.; Matthew Joseph Sheridan; Sigmund Stein, Ph.D.; Oscar Julian Steinhart, Ph.D.; Samuel Auchmuty Tucker, Ph.B.; Henry Trench Waller; Frank Edwin Weston; Edmund Thomas Whitaker, B.Sc.; William Ernest Wild, B.Sc.; William Williamson; Ernest Witham; Charles Arthur Wrench.

Of the following papers those marked thus * were read.

***86. "Preparation of a standard acid solution by direct absorption of hydrogen chloride." By G. T. Moody.**

A very rapid and accurate method of preparing a standard acid solution consists in absorbing hydrogen chloride in water, determining the resulting increase in weight, and subsequently diluting to a suitable bulk. The absorption is conveniently carried out in a conical glass flask, having a capacity of about 80 c.c., and closed by a glass stopper.

Through the stopper pass two tubes, one of which reaches nearly to the bottom of the flask and serves for delivery of the gas. From 2 to 4 grams of the gas may be absorbed in 40 c.c. of water in three minutes, and if the necessary apparatus for generating hydrogen chloride is kept fitted, a standard acid solution can be prepared in less than fifteen minutes.

***87. "Researches on the terpenes. III. Halogen derivatives of fenchene and their reactions." By John Addyman Gardner, M.A., and George Bertram Cockburn, B.A.**

The authors give a further account of the properties of chlorofenchenephosphonic acid, $C_{10}H_{14}Cl{\cdot}PO(OH)_2$ (*Trans.*, 1897, 71, 1156), and describe the halogen derivatives of fenchene produced during its formation. The first action of phosphorus pentachloride on fenchene results in the replacement of the oxygen atom by chlorine, and production of two isomeric liquid substances, termed α- and β-chlorofenchene hydrochloride. These two isomerides cannot be separated by fractional distillation, but distil together at 105°—110° under 16 mm. pressure. The α-isomeride is, however, very much the less stable of the two, and loses hydrogen chloride very readily, even when distilled with steam, producing chlorofenchene. The β-isomeride is much more stable towards reagents, and does not lose hydrogen chloride by boiling with aniline; this elimination can be effected, however, by prolonged heating with zinc dust and glacial acetic acid, and chlorofenchene is obtained. Unlike the chlorocamphene hydrochlorides, β-chlorofenchene hydrochloride is completely decomposed by warming with strong sulphuric acid, and yields no substance analogous to camphenol.

Chlorofenchene, $C_{10}H_{15}Cl$, is a crystalline substance very like chlorocamphene in appearance. It boils at 80—83° under 16 mm., and at 190—192° under the ordinary pressure. It is very soluble in alcohol, ether, benzene, light petroleum, chloroform, and carbon disulphide, the vapour of the last being sufficient to liquefy it. It has a specific rotatory power of $[\alpha]_D = +35{\cdot}92°$. Chlorofenchene slowly reacts with phosphorus pentachloride, and chlorofenchenephosphonic acid is formed on treating the product with water.

When sodium chlorofenchenephosphonate is treated with bromine water, it is decomposed quantitatively into sodium phosphate and *chlorobromofenchene*, $C_{10}H_{14}ClBr$; this is a colourless oil which boils at 113°—114° under 11 mm., but decomposes on boiling under atmospheric pressure. It has a specific gravity of 1·38039 at 16°, and a specific rotatory power of $[\alpha]_D = -8{\cdot}42°$. The halogen atoms cannot be eliminated by heating with aniline, with zinc dust and glacial acetic acid, or with sodium in methylic alcohol solution.

***88. "Researches on the terpenes. IV. On the oxidation of fenchone." By John Addyman Gardner and George Bertram Cockburn.**

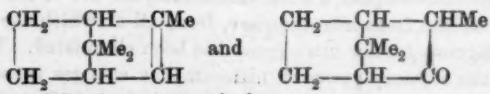
Fenchone is much more stable towards oxidising agents than camphor, but when oxidation does take place a much more complete breaking down of the molecule occurs. The authors have oxidised fenchone by prolonged heating on the water bath with concentrated nitric acid (sp. gr. 1·4). The action was very slow, and after heating for a week, they found that only about 50 per cent. of the ketone had been attacked. Isocamphoronic acid, dimethyltricarballylic acid, dimethylmalonic acid, isobutyric acid, acetic acid, and nitrofenchone were isolated from the product of oxidation.

The isocamphoronic acid crystallised from ether and ethylic acetate in tabular plates melting at 163—164°, and is identical with the isocamphoronic acid obtained by Tiemann from campholenic acid. The yield was about 1·5 per cent. of the weight of the fenchone actually oxidised.

The dimethyltricarballylic acid melted at 155°, and on treatment with acetic chloride gave an anhydride melting at 139—141°. The triethylic salt was a colourless liquid and boiled at 172—174° under 19 mm. pressure. The lead salt, $(C_8H_9O_6)_2Pb_3$, was an insoluble powder. The yield of this acid was 30 per cent., and of dimethylmalonic acid 4 per cent. of the fenchone oxidised.

Nitrofenchone is a colourless oil which distils at 146—151° under 14 mm. pressure, and on reduction with stannous chloride is converted into an amine.

The authors are of opinion that, if Bredt's formula be accepted for camphor, these results, taken together with the production of camphopyric acid from fenchene without the intermediate formation of camphoic acid, and from camphene, are sufficient to establish the formulæ



for fenchene and fenchone respectively.

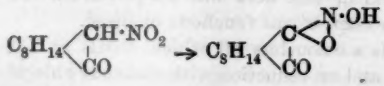
***89. "Nitrocamphor and its derivatives. Part I. Isodynamic forms of nitrocamphor." By T. M. Lowry, B.Sc.**

Although, theoretically, it should be possible to obtain two stereoisomerides of a compound represented by the formula $C_8H_{14}\begin{matrix}CH\cdot NO_2\\ CO\end{matrix}$, it appears that only one (the α') of the two possible forms of nitrocamphor

is produced under all ordinary conditions, since the various substances described as isomeric nitrocamphors have been found by the author to have the same properties when sufficiently purified.

The product obtained by heating nitrocamphor (*Proc.*, 1897, **13**, 169) has the formula $C_{20}H_{28}N_2O_5$, and is identical with a substance already described by Cazeneuve as nitrosocamphor (*Bull. Soc. Chim.*, 1888, iii, **1**, 558); it appears to be an *anhydride* formed by the removal of the elements of a molecule of water from two molecules of nitrocamphor, or rather of an isodynamic form of the latter which may be termed pseudonitrocamphor. This view finds support in the fact that the anhydride, like the salts formed from nitrocamphor, is strongly dextrorotatory, whereas nitrocamphor is lævorotatory; and that when heated or acted on by alcoholic potash, it breaks up into camphorquinone and nitrous oxide, undergoing a change analogous to that which Nef has shown to take place on acidifying a solution of sodium ψ-nitroethane (*Annalen*, 1894, **280**, 263).

If pseudonitrocamphor be represented by a formula corresponding to that which Hantzsch and Schultze have assigned to pseudophenylnitromethane, rather than by an isonitro-formula such as Nef has proposed, it is obvious that the conversion of nitrocamphor into the isodynamic form would not affect the asymmetry of the carbon atom to which the nitro-group is attached:



The author considers that important evidence of the independent existence of pseudonitrocamphor is afforded by the fact that solutions of nitrocamphor exhibit the phenomenon of multirotation hitherto observed only in the case of carbohydrates. This is true of $\pi\alpha'$-bromonitrocamphor, in which the group $-CH(NO_2)\cdot CO-$ is also present, but not of $\alpha'\alpha$-nitrochlorocamphor, $\alpha'\alpha$-nitrobromocamphor nor of the anhydride or salts obtained from nitrocamphor, from all of which the hydrogen atom contiguous to the nitro-group has been eliminated. The extent to which the rotatory power of nitrocamphor changes corresponds to the formation of from 5 to 10 per cent. of the pseudo-form in solution.

It has not been found possible to isolate pseudonitrocamphor as yet. In the case of $\pi\alpha'$-bromonitrocamphor, however, three different crystalline forms are known. The author is of opinion that the orthorhombic modification melting at 142°, which has a specific rotatory power changing from +189° to −40° in a 3·33 per cent. benzene solution, is the pseudo-form, and that the tetragonal form melting at 186°, which has a specific rotatory power changing from −50° to −40°, is the pure normal $\pi\alpha'$-bromonitrocamphor. The third microcrystalline

modification, melting at 126°, appears to be composed of the two isodynamic forms in the ratio of one part of the normal to about five of the pseudo-compound. Equilibrium is attained in solution by all the three modifications at a point corresponding to the presence of only about 4 per cent of the pseudo-compound; the fact that this form is nevertheless the one most readily obtained on crystallisation is not difficult to account for as it is much less soluble than the normal compound.

The camphornitrophenol which Cazeneuve obtained by the action of concentrated muriatic acid on nitrocamphor obviously represents a third form of isomerism, as it behaves as a saturated compound and shows phenolic properties. Its behaviour is not explained by the formula, $C_8H_{14}\begin{cases}C\cdot NO_2\\ \|\\ C\cdot OH\end{cases}$, proposed by Cazeneuve, since this represents it as being merely the enolic form of nitrocamphor. A change similar to that produced by hydrogen chloride occurs when benzoyl chloride acts on an alkaline solution of nitrocamphor, the product being camphornitrophenol benzoate. Cazeneuve has suggested that the formation of camphornitrophenol is due to the addition and subsequent loss of a molecular proportion of hydrogen chloride; it is possible that benzoyl chloride acts in a similar way by forming an additive compound from which hydrogen chloride is subsequently removed. The author is engaged in studying camphornitrophenol as well as its isomerides with a view of determining their interrelationships.

***90. "Cannabinol." By T. B. Wood, M.A; W. T. N. Spivey, M.A., and T. H. Easterfield, M.A., Ph.D.**

Notwithstanding the experimental evidence already adduced by the authors in favour of the homogeneity of cannabinol (*Trans.*, 1896, **69**, 539; *Proc.*, 1898, **14**, 66), further investigation has shown that the substance is a mixture.

The crystalline acetyl derivative to which the formula $C_{15}H_{18}O_2$ was assigned (*Proc., loc. cit.*) is found by molecular weight determinations to possess the formula $C_{23}H_{28}O_3$, which has the same percentage composition. This conclusion is supported by the determination of the acetyl and by the examination of the other product of hydrolysis, which has the composition and molecular weight required for the formula $C_{21}H_{26}O_2$. Most of the samples of cannabinol examined have yielded about 20 per cent. of the crystalline acetyl compound, together with an oily acetyl derivative containing a lower percentage of carbon.

The compound $C_{21}H_{26}O_2$ boils at 280—290° under 80 mm. pressure. When dissolved in glacial acetic acid and treated in the cold with

fuming nitric acid, it yields a bright yellow, crystalline *nitro*-derivative, $C_{21}H_{23}N_3O_8$, which is more conveniently obtained by the action of nitric acid on cannabinol under similar conditions, the yield amounting to 20 per cent. of the cannabinol used. This nitro-derivative melts at 160° with decomposition, has acid properties, and gives characteristic *ammonium*, *potassium*, and *silver* salts which are sparingly soluble in water, but dissolve easily in alcohol, and have the general formula $C_{21}H_{22}N_3O_8M$. The *sodium* salt is comparatively soluble and crystallises with four molecular proportions of water. On reduction, the nitro-compound yields a corresponding base. Hot fuming nitric acid oxidises the nitro-compound to nitrocannabinolactone (oxycannabin), a mixture of acids being produced at the same time.

Amidocannabinolactone, $C_{11}H_{11}NH_2O_2$ (*Proc., loc. cit.*), has been diazotised and converted into a crystalline *iodolactone*, $C_{11}H_{11}IO_2$, which melts at 137·5° and can be sublimed. On removal of iodine from this compound by the action of sodium amalgam an oily lactone is obtained.

*91. "An improved form of gas-analysis apparatus." By William A. Bone.

The author has devised an improved form of gas-analysis apparatus, suitable for all purposes where considerable accuracy in estimating small quantities of gases is required.

The apparatus consists essentially of:—(1) A measuring vessel, A, made in one piece with a barometer tube, B. Both A and B are 700 mm. long, and have the same internal and external diameters, viz., 15 and 17 mm. respectively. B is very accurately graduated into millimetres. A and B are enclosed in a rectangular water jacket through which a stream of water at a constant temperature can be made to flow, and are connected by means of special steel joints and a steel tap to a moveable mercury reservoir. (2) A laboratory vessel standing in a mahogany trough over mercury, into which the gases can be sent for absorption purposes. (3) An explosion vessel, similar to but rather larger than that of the Dittmar apparatus, in which all explosions are carried out.

The measuring vessel is provided with a three-way glass tap having two parallel capillary branches, one of which goes to the laboratory vessel, the other to the explosion vessel; the junctions are rendered vacuum tight by a device of steel faces and a clamp similar to that introduced by Regnault.

The moist gases are measured by bringing them to a certain constant volume in A and then deducing their tension in terms of millimetres of mercury from the reading on the barometer, B. Since the gases in A are moist and the 'vacuum' in B is always kept saturated with

water vapour, it is obvious that, provided the temperature of the water surrounding A and B remain constant throughout an analysis, none of the usual corrections for temperature, tension of water vapour, &c., need be applied to the analytical figures, as differences in readings on the barometer, under these conditions, correspond to differences in volume in the gases measured.

Discussion.

Professor McLeod thought that too much credit was ascribed to him for the gas-analysis apparatus, which was only a modification and simplification of that devised by Sir Edward Frankland. He had done away with the centre filling tube, so that a narrower glass cylinder which could be closed by an india-rubber plug was sufficient, thus avoiding complicated metal work; he had also lengthened the barometer, and thought that the author diminished the accuracy of his apparatus by making the barometer and measuring tube of the same length. All the stopcocks were made of glass, which seemed preferable to steel, as any leakage could be more easily detected and remedied. One small part of the apparatus he did claim, and that was the suspended globular mercury reservoir, and he was gratified to see that this simple device was in use in very many forms of apparatus in which mercury is employed.

Mr. G. N. Huntly said that he had been working for some time with a slightly modified form of the Frankland apparatus, in which the black glass points of Joly were used instead of lines etched round the tube. The accuracy of this method of reading is so great that a tube of one inch diameter can be used without loss of precision. The author's experience with the Dittmar-Lennox pipette did not agree with his own, as experiments made with a view of testing these pipettes showed that 5 c.c. of gas, measured initially at atmospheric pressure, could be transferred backwards and forwards repeatedly without the readings on the barometer tube differing by more than 0·1 mm., an accuracy of 1 in 7000. With careless working, transference tended, not to a loss of gas as the author suggested, but to a gain, minute air bubbles being introduced apparently from the fingers.

***92. "Preliminary note on the action of light on acetylene." By William A. Bone and John Wilson.**

Some time ago the authors noticed that acetylene undergoes a well marked change on exposure to bright sunlight. Tubes of about 100 c.c. capacity drawn out at each end and terminated by capillary glass taps were filled at atmospheric pressure with pure acetylene prepared from copper acetylide and dried by passing through a concentrated solution of potassium hydroxide. Some of these tubes were exposed on the

roof of the laboratory throughout June and July of last year when the weather was particularly fine. After two or three days' exposure, a faint brown deposit was observable on the inside of the bulbs. This gradually increased in extent and thickness until, at the end of a fortnight, the tubes were entirely covered with a dark brown, greasy deposit. The change was evidently due to the action of sunlight, for if a portion of the tube were screened from the light, no deposit was formed over the area so protected, and, further, after the tube had become coated with the opaque deposit no further action was noticeable even after prolonged exposure. Acetylene was decomposed to a less extent when exposed in tubes during August and September, 1897, than during the previous two months. The decomposition is independent of the presence of air, because acetylene mixed with its own volume of oxygen or nitrogen was exposed to sunlight for a very long period without any appreciable change occurring.

A slight contraction in volume was observed when tubes exposed during last summer were opened over mercury. A measured quantity of the gas sent into a Hempel pipette containing a freshly prepared ammoniacal solution of cuprous chloride was quickly reduced to about 2 per cent. of its original volume. The residual gas, after treatment with dilute sulphuric acid, appeared to contain a fairly dense hydrocarbon absorbed by fuming sulphuric acid, mixed possibly with a small quantity of hydrogen; no saturated hydrocarbon could be detected.

The solid deposit on the side of the tube was removed by treatment with fuming nitric acid, in which it does not dissolve to any appreciable extent. On removal of the acid by filtration, irregular, yellow plates remained. The acid filtrate was carefully tested for the presence of nitro-derivatives of benzene and naphthalene, but without success. The yellow plates were insoluble in hot benzene and could be heated at 270° without melting or undergoing any change; they apparently consisted of a very dense hydrocarbon or hydrocarbons.

The authors are working this summer on larger volumes of acetylene, and hope eventually to determine the nature of the products obtained.

***93. "Reversible zymohydrolysis." By Arthur Croft Hill, B.A.**

This investigation was undertaken to ascertain whether zymohydrolysis is a reversible process or not. The hydrolysis of maltose by maltase was selected for the purpose, the enzyme being obtained by extracting dry and finely powdered low-fermentation yeast, which had been heated under certain precautions, as detailed in the paper. It was found that the extract could be sterilised without destruction of its activity by filtration through a Pasteur-Chamberland filter.

The analytical methods for estimating the extent of hydrolysis were (1) determination of the cupric-reducing power of the mixed sugars; (2) determination of the specific rotatory power. The details of the methods and limits of accuracy are dealt with fully in the paper. To simplify calculations, maltose is reckoned as maltose hydrate, $C_{12}H_{22}O_{11},H_2O$.

The zymohydrolysis of maltose into glucose is hindered by the presence of glucose and is incomplete, and both these effects are more marked the more concentrated the solution of sugar. The retardation is shown by two sets of experiments. In the first set, the initial velocities of conversion are compared in a solution of maltose of a certain concentration with that in a solution of half maltose and half glucose of like total concentration. The ratio of these velocities should be not greater than 2, if the glucose were without influence; actually it is much greater, being about 3 for a 4 per cent., and 4·85 for a 20 per cent. sugar concentration. In the second set, the time curves are compared for two flasks, each containing initially the same concentration of maltose, while to one glucose has been added in equal concentration. If glucose were without influence, the time curve of conversion of maltose into glucose should be identical for each flask, but a much slower conversion occurs in that containing the added glucose, and the effect is much more marked with a total sugar concentration of 20 per cent. than with one of 4 per cent.

When the enzyme acts in a 20 per cent. solution of glucose, a small reverse action can be detected by the polarimeter. With a 40 per cent. concentration, the reverse action is well marked, and when sufficient time has been allowed for this action, which is a slow one, to approach completion, the reversion indicated by the change in rotatory and cupric-reducing powers amounts to 15 per cent. of the sugar. Control flasks show no change. With a 40 per cent. solution of sugar, of which 75 per cent. was glucose and 25 per cent. maltose (hydrate), hydrolysis proceeded till 83·25 per cent. of the total sugar was glucose, and the equilibrium point, therefore, for this concentration is not far from 84 parts glucose to 16 parts maltose (hydrate). Equilibrium points for various concentrations have been determined; and it is found that in dilute (2 per cent.) solutions hydrolysis is practically complete. The same equilibrium point is approached either with a solution of maltose or with one of glucose of the same concentration.

Maltose has been detected as a product of the reverse action by the use of phenylhydrazine. An osazone having a greater solubility in boiling water than glucosazone has been separated, and this crystallises in plates, has the same percentage of carbon and nitrogen as maltosazone, but melts at a temperature somewhat lower than maltosazone from pure maltose, though not lower than that prepared from ordinary maltose under similar conditions, viz., from a mixture of

maltose with excess of glucose to which some boiled enzyme solution has been added, the proteid being then removed as completely as possible before treatment with phenylhydrazine. The synthesised maltose has not yet been isolated, but it is considered that the evidence of its presence, coupled with the increase of optical rotatory power and corresponding decrease in cupric-reducing power observed in concentrated glucose solutions in the presence of maltase, justify the conclusion that the zymohydrolysis of maltose is a reversible process.

Discussion.

Dr. Horace Brown congratulated the author on the important results he had obtained, and stated that, although some such reversed action was recognised when dextrose is acted on by dilute acids, this was the first time that anything of the kind had been shown to occur during prolonged enzyme action. He had been privileged to see the details of the author's work whilst it was in progress, and was quite satisfied that a reversal had really taken place. The alteration in optical and reducing properties, and the appearance of the osazone pointed strongly to the reversed product being ordinary maltose, but until this was isolated, and such isolation ought not to present any insuperable difficulties, he did not feel quite satisfied as to its nature. It could not be identical, however, with the isomaltose obtained by Emil Fischer by the action of acid on dextrose.

Mr. Ling thought that additional evidence was necessary before it could be definitely concluded that maltose was produced from glucose, and, as a possible means of deciding the question, suggested converting the product into acetyl derivatives instead of into osazones. Octacetylmaltose was a well characterised compound, and could, he thought, be separated from the acetyl derivatives of glucose.

94. "The solubility of isomeric substances." By James Walker Ph.D., D.Sc., and John K. Wood, B.Sc.

In continuation of a research by Carnelley and Thomson (*Trans.*, 1888, 53, 782), the authors have investigated the solubility of the hydroxybenzoic acids, and the isomeric ureas, $C_7H_8N\cdot CO\cdot NH_2$, in various solvents.

The values obtained for the solubility of salicylic acid at different temperatures are one-third less than the values given by Bourgoin. The variation of the solubility of the hydroxybenzoic acids in water with the temperature is expressible up to 50° by a formula of the type proposed by Nordenskjöld, the equations being, for the ortho-acid, $\log S = 0{\cdot}01556t - 1{\cdot}0458$; for the meta-acid, $\log S = 0{\cdot}01793t - 0{\cdot}4188$; and for the para-acid, $\log S = 0{\cdot}0227t - 0{\cdot}7972$. With benzene as

solvent, a formula of this type does not express the variation of the solubility with the temperature.

Congo red was found to be the best acidimetric indicator for salicylic acid and its isomerides.

The rule that the order of fusibility of isomeric substances is also the order of their solubility does not hold good for the hydroxybenzoic acids, but it is in general applicable to benzyl urea and its isomerides.

The rule that the order of solubility of isomerides is independent of the solvent is not strictly applicable in either of the cases investigated. The constancy of the solubility ratio observed by Carnelley and Thomson for para- and meta-nitraniline is not found either with the acids or with the ureas. The solubility ratios of the hydroxybenzoic acids in the same solvent vary considerably with the temperature.

95. "Note on nitration and substitution in nitro-compounds." By Arthur Lapworth, D.Sc., and Charles Mills.

It is known that (1) nitro-compounds yield chiefly meta-derivatives with most substituting agents, but orthonitrophenols when acted on by alkaline ferricyanide; (2) ortho- and para-chloronitrobenzene form the corresponding nitrophenols by interaction with alkalis, whilst the meta-compound is not affected; (3) ortho- and para-ethoxynitrobenzene are converted into the corresponding nitranilines on treatment with ammonia, but the meta-derivative is not affected. The authors consider that these facts are in complete accordance with the view of substitution advocated by one of them (*Trans.*, 1898, **73**, 445), namely, that substitution in nitro-compounds is largely due to the occurrence of successive, irreversible, desmotropic changes in products formed by the addition of the acting agent to the side group.

In the hope of showing that when acid oxidising agents act on nitro-compounds, ortho- or para-nitrophenols, if any, would be produced, the authors undertook the investigation of an acid substance formed under certain conditions during the nitration of toluene. As ortho- and para-nitrotoluenes are the chief products of that reaction, it was thought probable that this substance had been formed from one of these. Examination showed, however, that oxidation of toluene had doubtless been the first action, as the substance was identified as dinitroparacresol $[Me : OH : (NO_2)_2 = 1 : 4 : 3 : 5]$, and thus contained both nitro-groups in meta-positions relatively to the methyl radicle.

96. "Hydroxydibromocamphorsulphonic acid. A correction." By Arthur Lapworth, D.Sc., and F. Stanley Kipping, D.Sc., F.R.S.

In a paper on "Sulphocamphoric acid and other derivatives of camphorsulphonic acid" the authors described as "hydroxydibromo-

camphorsulphonic acid, $C_{10}H_{14}Br_2SO_5$," a compound obtained by oxidising ammonium α-bromocamphorsulphonate with nitric acid (*Trans.*, 1897, 71, 19). This composition was assigned to the oxidation product in question, partly from the results of analyses, partly from the study of a well-defined crystalline sulpholactone, $C_{10}H_{12}Br_2SO_4$, which was obtained simultaneously with the acid, and into which the acid was found to be convertible under certain specified conditions. At the same time, it was admitted that no direct evidence of the presence of a hydroxyl group in the acid had been obtained, and that, although the conversion of the acid into the lactone had been accomplished, the method by which this change was brought about was difficult to explain.

Further investigation has shown that the supposed "hydroxy-acid, $C_{10}H_{14}Br_2SO_5$," is in reality a *hydrated dibromocamphorsulphonic acid*, $C_{10}H_{14}Br_2SO_4,H_2O$, so that its conversion into the lactone by the process employed (boiling with aqueous silver nitrate) is now explained as a simple oxidation followed by elimination of the elements of water. The analyses already referred to gave results agreeing just as well with those required by the new (C = 29·4; H = 3·9; Br = 39·2; S = 7·8 per cent.) as with those calculated for the original formula, and further analyses have given equally satisfactory results (C = 29·7; H = 3·8; Br = 39·4). The *anhydrous acid* was only obtained with difficulty owing to the water of crystallisation in the hydrated compound being very obstinately retained; it crystallised from petroleum and ether in slender prisms melting with decomposition at 245—252°, and on analysis gave the following results ($C_{10}H_{14}Br_2SO_4$ requires C = 30·8; H = 3·6; Br = 41·0. Found C = 30·5; H = 3·6; Br = 41·2 per cent.).

One of the authors has now obtained the acid by a method which confirms this view of its composition, and its investigation is being continued.

97. "Enantiomorphism." By F. Stanley Kipping, D.Sc., F.R.S., and William Jackson Pope.

The authors have previously shown (*Proc.*, 1896, 12, 249) that, on crystallising the cubic tetartohedral sodium chlorate from aqueous solutions containing various optically active carbohydrates, the two enantiomorphously related crystalline forms of sodium chlorate are deposited in different numbers; numerical data respecting the ratios of the numbers in which dextro- and lævo-crystals of sodium chlorate separate from solutions containing dextroglucose, mannitol, dulcitol, and isodulcitol are now given. A saturated solution of sodium chlorate containing 200 grams of *d*-glucose per litre deposits on crystallisation

an average of 31·75 per cent. of dextro- and 68·25 per cent. of lævo-crystals of sodium chlorate by number; results showing that a similar enantiomorphous influence is exercised on the crystallisation of sodium chlorate by other carbohydrates are also given.

Data have also been obtained respecting the proportion in which dextro- and lævo-crystals of sodium chlorate separate from pure aqueous solutions; the examination of a large number of crops of crystals shows that 50·08 ± 0·11 per cent. of the deposited crystals are dextrorotatory.

98. "Azobenzene derivatives of chrysin, euxanthone, gentisin, and morin." By A. G. Perkin.

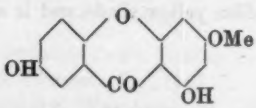
It has been previously shown that apigenin, the colouring matter of parsley, *Apium petroselinum* (*Trans.*, 1897, 71, 805), forms a disazo-derivative, and that during its purification with nitrobenzene and acetic acid a bye-product is obtained, which is evidently an acetyl compound (*Proc.*, 1897, **13**, 54). Thus prepared, the latter is apt to be impure, and is best formed by the prolonged digestion of disazobenzeneapigenin with boiling acetic anhydride. It forms orange-red needles melting at 277—280° when rapidly heated, and in general properties is almost indistinguishable from the disazo-compound itself.

Chrysin, the colouring matter of poplar buds, yields a *disazo*-derivative, $C_{15}H_8O_4(N_2Ph)_2$, which crystallises in orange-coloured needles, melts at 250—252°, and is insoluble in alkaline solutions. It contains no free hydroxyl groups.

The diazobenzene groups in these compounds are thus adjacent to the two hydroxyl radicles of the phloroglucinol nucleus, and the results harmonise with previous work which indicated that apigenin is a hydroxychrysin.

Euxanthone, derived from the Indian dye-stuff "purree," yields *disazobenzene-euxanthone*, $C_{13}H_6O_4(N_2Ph)_2$, which crystallises in brick-red needles, melts at 249—250°, and is almost insoluble in alkalis. Acetic anhydride converts it into a *diacetyl* compound, $C_{13}H_4O_4Ac_2(N_2Ph)_2$, which forms olive-coloured needles and melts at 197—199°.

From gentisin, *disazobenzenegentisin*, $C_{14}H_8O_5(N_2Ph)_2$, is obtained. This crystallises in orange-red needles, melts at 218—220°, and yields a *diacetyl* derivative, $C_{14}H_6O_5Ac_2(N_2Ph)_2$. These results indicate that the methoxyl group in gentisin has the following position:



Disazobenzenemorin, $C_{15}H_8O_7(N_2Ph)_2$, a red-brown, crystalline pow-

der, is formed in very small quantity by the interaction of diazobenzene sulphate with morin in alkaline solution. No trisazo-compound could be obtained.

99. "Constituents of the Indian dyestuff 'waras.'" By A. G. Perkin.

Waras is a purplish powder which covers the seed pods of *Flemingia congesta*, an erect, woody shrub of Africa and India. In its general properties and microscopic appearance it closely resembles kamala (*Mallotus Phillipinensis*) previously investigated (*Trans.*, 1893, 63, 975; 1894, 65, 232). For the supply of material, which is very difficult to procure, the author is indebted to the authorities of the Imperial Institute.

Flemingin, $C_{12}H_{12}O_3$, the principal crystalline constituent, was obtained as an orange-red powder consisting of small, prismatic needles melting at 171—172°. In appearance and numerous properties it resembles the rottlerin of kamala, but is distinguished from this by its solubility in alcohol, and by the browner tint of its alkaline solutions In an alkaline bath, it dyes silk a golden yellow, and is a stronger dyestuff than rottlerin. On fusion with alkali, it gave acetic acid, salicylic acid, and an acid of higher melting point which was not identified.

Homoflemingin (C = 69·97; H = 5·75), present only in minute quantity, forms glistening, yellow needles, melts at 164—166°, and possesses properties resembling those of flemingin.

The *resin of high melting point*, $C_{12}H_{12}O_3$, forms a brick-red powder soluble in alkali, with a deep brown tint, and yields acetic and salicylic acids on fusion with alkali. It dyes silk in shades which are redder than those produced by flemingin.

The *resin of low melting point*, $C_{13}H_{14}O_3$, is a deep orange-brown, transparent mass which melts below 100°, is soluble in alkali with an orange-brown colour, and closely resembles the resin of low melting point of kamala. On fusion with alkali, acetic and salicylic acids are obtained, and on boiling with nitric acid (sp. gr. 1·5) oxalic acid is formed.

From numerous characteristic reactions described in the paper, it is concluded that the above substances are closely related to, though not identical with those present in kamala.

Waras dyes silk a golden yellow shade, and is a much stronger dyestuff than kamala.

100. "Note on the oxidation of charcoal by nitric acid." By G. Dickson, M.A., and T. H. Easterfield, M.A., Ph.D.

Well-burnt charcoal reacts readily with fuming nitric acid, the action being accompanied by a considerable rise of temperature. When boiled for 24 hours with fuming nitric acid, the charcoal goes entirely into solution, and on dilution with water a black, amorphous substance is precipitated, whilst mellitic and non-crystalline acids remain in solution. The black, amorphous substance resembles the "mellogen" of Bartoli and Papasogli (*Gazz.*, 1882, 12, 117); it is easily soluble in alkali, and on oxidation by alkaline permanganate yields oxalic and mellitic acids in about equal proportions.

From charcoal, 25 per cent. of its weight of crystalline ammonium mellitate can be obtained by the following process. The charcoal is boiled with fuming nitric acid for 24 hours and further oxidised by adding potassium chlorate to the boiling solution; the organic acids, after precipitation as barium salts, are converted into ammonium salts. The yield of mellitic acid varies only slightly, whether the charcoal contains 2 or only 0·2 per cent. of hydrogen. Coal under similar conditions gives only a small yield of mellitic acid.

Even nitric acid of sp. gr. 1·1 can oxidise well-burnt charcoal. After boiling continuously for seven days, the charcoal is changed to a black, impalpable mud, soluble in alkali. The nitric acid solution contains mellitic but no oxalic acid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

British Pharmacopœia, The. Pp. xxxii + 535. London 1898.
From the General Medical Council.

Lupton, Sydney. Notes on Observations; being an outline of the methods used for determining the meaning and value of quantitative observations and experiments in Physics and Chemistry, and for reducing the results obtained. Pp. ix + 126. London 1898.
From the Author.

II. *By Purchase.*

Jones, H. C. The Freezing Point, Boiling Point, and Conductivity Methods. Pp. vii + 64. Easton, Pa., 1897.

Mez, C. Mikroskopische Wasseranalyse. Anleitung zur Untersuchung des Wassers mit besonderer Berücksichtigung von Trink- und

Abwasser. Pp. xvii + 631. Mit 8 lithographisten Tafeln und in den Text gedruckten Abbildungen. Berlin 1898.

Ryn, W. van. Die Stereochemie des Stickstoffs. Gekrönte Preisschrift von der Universität Zürich. Pp. 148. Zürich 1897.

Threlfall, R. On Laboratory Arts. Pp. xii + 338. London 1898.

BANQUET TO PAST PRESIDENTS.

The Banquet to Past Presidents, unavoidably postponed from June 9th, has been finally fixed by the Council for Friday, November 11th.

COLLECTIVE INDEX.

The Collective Index for 1883—1892 is ready for distribution to Fellows who joined the Society prior to December 31st, 1892, and notified to the Assistant Secretary before December 31st, 1895, their wish to receive a copy.

Fellows who are ineligible to receive copies *gratis*, and those who may have neglected to apply for them prior to December 31st, 1895, may obtain the Index from the Assistant Secretary at the price of 15*s*., or 16*s*. including carriage.

Non-members may obtain copies from Messrs. Gurney and Jackson, 1, Paternoster Row, E.C., at the price of £1, excluding carriage.

Supplementary title pages are furnished to those who may wish to bind the Index of Authors and Index of Subjects as separate volumes.

The Collective Index for 1873—1882 is in course of preparation, and will be published during the next Session.

LIBRARY.

The Library will be closed during the last fortnight in August for cleaning and for the annual revision of the Catalogue. Fellows are requested to return all books in their possession not later than August 8th.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 9/11/1898

PROCEEDINGS
OF THE
CHEMICAL SOCIETY.
EDITED BY THE SECRETARIES.

No. 198. Session 1898–9.

The following are the abstracts of papers received during the vacation and published in the *Transactions*:—

101. "The vapour pressures, specific volumes, and critical constants of normal heptane." By Sydney Young, D.Sc., F.R.S.

The critical constants of the specimen of normal heptane obtained by Dr. Thorpe from *Pinus sabiniana* are:—temperature, 266·9°; pressure, 20415 mm.; volume of a gram, 4·266 c.c.

A comparison of the ratios of the absolute temperatures (boiling points) and volumes (liquid and saturated vapour) to the critical constants with those of normal pentane and normal hexane at "corresponding" pressures, shows that, whilst the deviations from constancy are small, the temperature ratios are certainly, and the volume ratios are probably, related to the molecular weights of the paraffins, but a full discussion of this relationship is reserved until the data for normal octane have been obtained.

102. "Contributions to the chemistry of phenol derivatives." By Raphael Meldola and Frederick Henry Streatfeild.

When phenol is brominated in acetic acid solution with one molecular proportion of bromine, and the product afterwards nitrated, a mixture of 4-bromo-2-nitrophenol and 2-bromo-4:6-dinitrophenol is always obtained (*Trans.*, 1896, 69, 1326). In the present paper, the authors show that the bromodinitrophenol is the result of the nitration of both the para- and ortho-bromophenols present in the crude product. The presence of orthobromophenol is proved by the formation of 2-bromo-4-nitrophenol, which the authors have succeeded in isolating from the mixture of nitro-derivatives. The formation of 2-bromo-4:6-dinitrophenol from parabromophenol is not due to

"isomeric change" as ordinarily understood, since the first product of the nitration of 4-bromo-2-nitrophenol under the conditions of nitration employed is 4-bromo-2 : 6-dinitrophenol, and this undergoes isomeric change only when heated with bromine and water (Armstrong, *Trans.*, 1875, **28**, 520), or nitric acid (Gordon, *Proc.*, 1891, **7**, 64), or at ordinary temperatures when the solution in excess of fuming nitric acid is allowed to stand for about two hours. The statement of Hübner and Brenken (*Ber.*, 1873, **6**, 170) that when phenol is brominated in acetic acid and the solid (para) bromophenol frozen out a liquid isomeride in the mother liquor remains, is thus confirmed. At the same time, the suspicion expressed by Armstrong (*loc. cit.*, 521) that pure parabromophenol gives some "bromo-α-dinitrophenol" on nitration, is also confirmed.

The authors have also studied the products of the nitration of pure orthobromophenol. These are 2-bromo-4-nitrophenol (m. p. 112°) and 2-bromo-6-nitrophenol, a new modification (m. p. 67—68°), of which the silver, barium, potassium, and methyl salts are described.

On limited reduction, 4-bromo-2 : 6-dinitrophenol yields 4-bromo-2-nitro-6-aminophenol (m. p. 141—142°), from which the acetyl derivative (m. p. 161—162°), the methyl ether (m. p. 81—82°), and 4-bromo-2 : 6-dinitraniline were prepared.

The following derivatives of guaiacol were also obtained: 4-bromo-2-nitroguaiacol (m. p. 103—104°), 2-bromo-4-nitroguaiacol (m. p. 142°), and acetamidoguaiacol [OH : OMe : NHAc = 1 : 2 : 6], crystallising from water with $1H_2O$, which is lost at 100°.

103. "Some iodoso-compounds." By John McCrae, Ph.D.

In order to ascertain whether diortho-substituted phenylic iodides yield dichlorides and iodoso-derivatives, the behaviour of orthiodo-dimetadibromotoluene and symmetrical tribromiodobenzene was investigated. The dichlorides were not obtained quite so easily as in the cases of simpler iodides, but this is due to the fact that the iodide dichlorides of these two compounds are more easily soluble in chloroform than the iodides themselves; consequently the dichlorides did not separate until some of the chloroform had evaporated. The dichloride, iodoso-, and iodoxy-derivatives of 5-nitro-2-iodotoluene were also prepared.

104. "On myrticolorin, the yellow dye material of Eucalyptus leaves." By Henry G. Smith.

Myrticolorin, $C_{27}H_{28}O_{16}$, exists in large quantity in the leaves of the "Red Stringy Bark," *Eucalyptus macrorhyncha*, and is a new glucoside of quercetin occupying an intermediate position between

osyritrin, $C_{27}H_{30}O_{17}$, obtained from the Cape sumach (A. G. Perkin, *Trans.*, 1897, 71, 1132), and Viola quercitrin, $C_{27}H_{26}O_{15}$, from the flowers of *Viola tricolor variensis*.

The sugar gave an osazone melting with slight decomposition at 180° when slowly heated, and at 190° with rapid decomposition when rapidly heated. As the osazone of galactose is indicated by these results, and as manna containing sugars is not obtained from the group of Eucalypts to which *E. macrorhyncha* belongs, whilst the principal sugar of the members of the group which do exude manna is raffinose, the question becomes one of importance, and the sugar of myrticolorin will be further examined.

In colour, melting point, reactions with reagents, and dyeing power, no differences could be detected between myrticolorin and osyritrin, a specimen of which had been forwarded by Mr. A. G. Perkin for comparison.

105. "Chemical properties of concentrated solutions of certain salts. Part II. Double potassium succinates." By William Colebrook Reynolds.

The result of the addition of many metallic salts to a concentrated solution of potassium succinate resembles that obtained with a concentrated solution of potassium carbonate (*Trans.*, 1898, 73, 262). Crystalline double succinates, more or less soluble in the solution, were obtained instead of the insoluble metallic succinates in the case of nickel, zinc, cobalt, lead and calcium.

106. "Additive compounds of organic bases and ethereal salts of unsaturated acids." By S. Ruhemann and K. C. Browning.

The authors have found that the view expressed by Ruhemann and Hemmy (*Trans.*, 1897, 71, 334) with respect to the mode of formation of the compound regarded provisionally as triethylic anhydro-oxalaconitate is correct, as ethylic oxalacetate alone takes part in the reaction. Whilst endeavouring to determine the constitution of that substance, they have observed that piperidine forms additive compounds with ethereal salts of unsaturated acids. These distil in a vacuum without decomposition, have basic properties, and form hydrochlorides which are very soluble in water. The following additive compounds are described: ethylic piperidylsuccinate (b. p. 159° at 10 mm.), ethylic piperidylpyrotartrate (b. p. 163—164° at 10 mm.), ethylic piperidyltricarballylate (b. p. 201—202° at 10 mm.), and ethylic piperidylcinnamate (b. p. 220—221° at 11 mm.).

107. "Formation of ethereal salts of β-ketonic acids." By S. Ruhemann and K. C. Browning.

Adopting Michael's method for the formation of ethereal salts of β-ketonic acids by the combination of ethylic sodio-acetoacetate with the ethylic salts of unsaturated acids, the authors have prepared ethylic α-acetotricarballylate (b. p. 187—188° at 11 mm.), ethylic acetoethyltricarballylate (b. p. 194—196° at 9 mm,), ethylic α-benzoyltricarballylate (b. p. 244—245° at 10 mm.), and ethylic α-acetobutanetetracarboxylate (b. p. 222—223° at 10 mm.).

108. "Disulphonic acids of toluene, of ortho- and para-toluidine, and of ortho- and para-chlorotoluene." By William Palmer Wynne, D.Sc., F.R.S., and James Bruce, B.Sc.

The authors correct certain errors which occur in their previous communication (*Proc.*, 1895, 11, 153), and show that the para-toluidinedisulphonic acids obtained by Richter from the 1 : 4 : 3- and 1 : 4 : 2-paratoluidinesulphonic acids (*Annalen*, 1885, 230, 314, 331) are the 1 : 4 : 3 : 5- and 1 : 4 : 2 : 5-derivatives respectively. They also show that the toluenedisulphonic acid previously described as the 1 : 2 : 6-derivative is the 1 : 2 : 5-compound.

Paratoluidine-3 : 5- and -2 : 5-disulphonic acids, and orthotoluidine-3 : 5- and -4 : 5-disulphonic acids, together with the corresponding chloro-acids, are described, and the statements of Hasse (*Annalen*, 1885, 230, 286) with respect to the bromotoluenedisulphonic and toluene-disulphonic acids derived from orthotoluidine-3 : 5-disulphonic acid are shown to be erroneous.

Parachlorotoluene-3- and -2-sulphonic acids, and orthochlorotoluene-4-sulphonic acid, together with the disulphonic acids derived from them by further sulphonation, are described, and the conclusion is drawn that the mixture of monosulphonic acids obtained on sulphonating parachlorotoluene contains not more than 14 per cent. of the 1 : 4 : 3-isomeride.

Incidentally, the list of six toluenedisulphonic acids given by Klason (*Ber.*, 1887, 20, 350) has been revised, and it is shown that only five of the six acids theoretically possible are known. Experiments are in progress with the object of obtaining the missing 1 : 2 : 3-isomeride.

109. "Chlorine derivatives of pyridine. Part II. Interaction of ammonia and pentachloropyridine. Constitution of glutazin." By W. T. Sell, M.A., and F. W. Dootson, M.A.

The authors describe the preparation from pentachloropyridine of γ-amidotetrachloropyridine, (presumably α-) amidotetrachloropyridine,

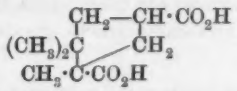
diamidotrichloropyridine, and hydroxytetrachloropyridine. γ-Amidotetrachloropyridine is identical with the compound obtained by Stokes and Pechmann (*Ber.*, 1887, **20**, 2655) from glutazin, and thus demonstrates the presence of an amido-group in the latter substance.

110. "Mercury acetamide." By M. O. Forster, Ph.D., B.Sc.

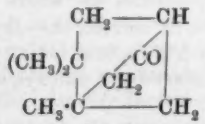
Mercury acetamide liberates nitrogen from hydroxylamine, hydroxylamine hydrochloride, hydrazine, hydrazine hydrochloride, and phenylhydrazine, being resolved by these substances into acetamide and mercury, which, in the case of the salts mentioned, are accompanied by calomel; the products from phenylhydrazine are aniline, benzene, and mercury diphenyl. Phenylhydroxylamine is converted into nitrosobenzene and azoxybenzene by the agency of mercury acetamide, which transforms hydrazobenzene into azobenzene. Nitrosophenylhydroxylamine, aniline, and diazoamidobenzene yield additive compounds with mercury acetamide.

111. "Sulphocamphylic acid and isolauronolic acid, with remarks on the constitution of camphor and of some of its derivatives." By W. H. Perkin, jun.

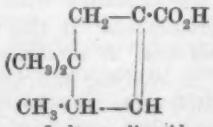
In this communication, the author shows that the results which he and others have obtained in the investigation of isolauronolic acid can, apparently, be explained only on the assumption that camphoric acid has the formula



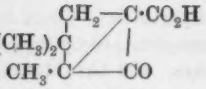
With the aid of this formula, the oxidation of isolauronolic acid, $C_9H_{14}O_2$, to isolauronic acid, $C_9H_{12}O_3$, and further to γ-acetyldimethylbutyric acid, $CH_3\cdot CO\cdot C(CH_3)_2\cdot CH_2\cdot CH_2\cdot CO_2H$, is readily understood. Assuming that the above constitution for camphoric acid is correct, the author deduces the following formulæ as probably representing the constitution of some of the more important members of the camphor group:—



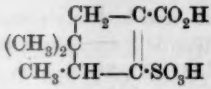
Camphor.



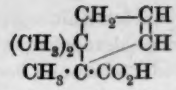
Isolauronolic acid.



Isolauronic acid.



Sulphocamphylic acid.



Lauronolic acid.

These formulæ are shown to explain the properties of the substances in a satisfactory manner.

112. "Researches on the terpenes. VIII. On carvenol: its reactions and products." By J. E. Marsh and A. Hartridge.

Carvenol, the product of the action of strong sulphuric acid on chlorocamphene, and previously described as hydroxycamphene or camphenol (Trans., 1897, 71, 290), has been further examined. It has been found to yield chlorocymene [Me : Cl : Pr^{β} = 1 : 2 : 4] by the action of phosphorus pentachloride, and paracymene by the action of benzoic chloride. It is reduced by sodium in alcoholic solution, forming the secondary alcohol *carvanol*, $C_{10}H_{20}O$, which is hexahydrocarvacrol. This latter compound yields, on oxidation, the saturated ketone *carvanone*, $C_{10}H_{18}O$.

The production from camphor of cymene and chlorocymene by comparatively simple reactions, and also of reduced cymene derivatives, brings into prominence the close relationship which must exist between camphor and cymene. Not only do formulæ which fail to express this relationship in the arrangement of the carbon atoms lose the chief support on which any formula for camphor must rely, but, further, in view of the production of chlorocamphene, a saturated compound, no formula can be admitted which leads to the representation of camphene and chlorocamphene as unsaturated compounds.

113. "Optically active alkyloxypropionic acids." By Thomas Purdie, F.R.S., and G. Druce Lander, B.Sc.

As the product of the action of isopropylic iodide on inactive silver lactate contains a considerable quantity of isopropylic isopropoxypropionate (*Trans.*, 1898, 73, 296) the authors concluded that the abnormally high rotation of the active ethereal lactates prepared by the silver salt method (*Trans.*, 1895, 67, 916; 1896, 69, 830) was due to their contamination with small quantities of active ethereal alkyloxypropionates. If this conclusion is correct, the alkyloxypropionic acids must be substances of very high optical activity. With the view of verifying this, the active α-methoxy-, ethoxy-, and propoxy-propionic acids have been prepared.

As complete racemisation occurs during the action of sodium

ethylate on active ethylic chloro- and bromo-propionates (*Trans.*, 1896, **69**, 819), the active alkyloxy-acids were prepared by the resolution of the inactive acids with alkaloids. The resolution of ethoxypropionic acid was carried out with cinchonidine, and more completely with morphine, the salt of the dextro-acid being in both cases the less soluble. The methoxy- and propoxy-acids were also resolved with both alkaloids, but the resolution with cinchonidine was far from complete. In the case of the methoxy-acid, both alkaloids precipitate first the lævo-acid; in the case of the propoxy-acid, the cinchonidine salt of the lævo- and morphine salt of the dextro-acid are first deposited. The authors point out that the results of their experiments are not in harmony with the theory of Winther (*Ber.*, 1895, **28**, 3000).

Polarimetric observations were made on the *l*-methoxy-, *d*-ethoxy- and *d*-propoxy-acids, and on their sodium and calcium salts, also on barium and silver *d*-ethoxypropionates. The substitution of the alcoholic hydrogen of the lactates by an alkyl group produces, as was expected, a great increase of optical activity. Thus the molecular rotation of the alkaline lactates in dilute aqueous solution is 14·5°, while that of sodium ethoxypropionate is 68·77°. Increase in the weight of the introduced alkyl group produces a very much smaller but still distinct rise of molecular rotation. The rotations of the salts increase with dilution, and in general conform to the law of Oudemans and Landolt; those of the acids diminish. The changes of rotation with varying concentration are, as might be expected from the disappearance of the hydroxyl group, of a more normal kind than in the case of lactic acid and the lactates, but the authors conclude that even in the case of the alkyloxy-acids, the rotation is influenced by other factors connected with the solvent besides electrolytic dissociation.

114. "The optical activity of gallotannic acid." By Otto Rosenheim Ph.D., and Philip Schidrowitz, Ph.D.

The authors have examined a number of commercial "pure" gallotannic acids and find that, whilst they varied in optical activity from $[\alpha]_D + 11°$ to $[\alpha]_D + 74·2°$, they all contain from 50 to 75 per cent. of a uniform gallotannic acid possessing an optical activity of approximately $[\alpha]_D + 75°$. The authors ascribe this great difference to the fact that the commercial substances contain varying quantities of gallic acid, which is inactive, and mineral matter, which possesses a great influence on rotatory power. Acetyl derivatives and quinine salts prepared from the commercial samples are respectively identical in optical activity among themselves and with the products obtained from the homogeneous substance isolated by the authors' method.

115. "The influences modifying the specific rotatory power of gallotannic acid." By Otto Rosenheim, Ph.D., and Philip Schidrowitz, Ph.D.

The authors have examined the modifying influence of: (*a*) concentration, (*b*) nature of the solvent, and (*c*) optically inactive substances, on the specific rotation of gallotannic acid. The material used for these experiments was the homogeneous product obtained by methods described in the preceding paper. The results were as follows:—

(*a*) Concentration.—In aqueous solutions containing not more than one per cent., the rotation is constant at $[\alpha]_D^{15}+75{\cdot}2°$. From 1 to 10 per cent., the rotation decreases gradually to $[\alpha]_D^{15}+66{\cdot}1°$.

(*b*) Nature of the solvent.—The optical activity of gallotannic acid depends to a very marked extent on the nature of the solvent. Thus the original specific rotation $[\alpha]_D^{15}+75{\cdot}2°$ (for water) is reduced to $\pm 0°$ for a mixture of acetone and carbon tetrachloride. Alcohol, ethylic acetate, &c., and mixtures of acetone with ether, &c., have a powerful depressing action, and the gross effect produced is greater in the case of gallotannic acid than in that of any other substance hitherto examined.

(*c*) Influence of optically inactive substances.—(1) Acids.—Mineral acids have no influence. Acetic acid has a depressing effect, but this is probably due to partial acetylation. Gallic acid has no influence. (2) Ammonia.—A few drops added to a one per cent. solution produce total inactivity. (3) Salts.—Salts, such as sodium tungstate, sodium, potassium, ammonium and lithium biborates and chlorides, sodium and potassium bicarbonates, and zinc acetate, exercise a very marked influence on the rotation of gallotannic acid. In the majority of cases, the addition of increasing amounts of salt produces a decrease in the specific rotation until a minimum is attained, the further addition of salt causing a gradual rise. The molecular rotations of the mixtures at the minima are approximately constant and equal to the molecular rotation of gallotannic acid alone.

116. "The non-resolution of racemic tetrahydropapaverine by tartaric acid." By William Jackson Pope and Stanley John Peachey.

Prior to the publication of Goldschmiedt's paper (*Monats.*, 1898, **19**, 321), the authors had prepared the dextrotartrate of racemic tetrahydropapaverine in the course of their work on the resolution of the base into its optically active components (*Proc.*, 1898, **14**, 122). The salt has the composition assigned to it by Goldschmiedt, and belongs

to the monosymmetric system; $a:b:c = 1{\cdot}1464:1:0{\cdot}7932$; $\beta = 82°\ 30'$. Its molecular rotation was found to be $[M]_D = +63{\cdot}44°$, a value agreeing with those obtained for the metallic tartrates in dilute aqueous solution, namely, 58·1 to 64·6 (Landolt, *Ber.*, 1873, **6**, 1077).

Ladenburg has described as "hemiracemic," salts in which either the acid or the base is racemic whilst the other constituent is optically active, and has examined two salts of the kind, namely, quinine racemic pyrotartrate (*Ber.*, 1898, **31**, 524, 937) and strychnine racemate (*Ber.*, 1898, **31**, 1969). Racemic tetrahydropapaverine dextrotartrate is thus the first case of the kind in which a racemic base is combined with an optically active acid.

November 3rd, 1898. Professor Dewar, F.R.S., President, in the Chair.

Messrs. L. M. Nash, A. J. Parker, W. A. Lethbridge, F. E. Weston, and W. C. Reynolds were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Hugh Poynter Bell, 30 Egerton Crescent, S.W.; Reginald Arthur Berry, The University Chemical Laboratory, Cambridge; Thomas Henry Boardman, 4 St. George's Terrace, Wilton, Taunton; Marston Taylor Bogert, 259 Broadway, Flushing, New York; Arthur Brooke, 17 Cavendish Square, Hull; Johannes Christian Brunnich, Agricultural College, Gatton, Queensland; John Paul de Castro, Ford House, Redruth, Cornwall; David Leonard Chapman, Hulme Hall, Plymouth Grove, Manchester; William Samuel Crouch, Colombo, Ceylon; Alfred Valentine Cunnington, Christ's College, Cambridge; William Brown Davidson, 29 Bedford Street, Liverpool; Samuel Dickson, The Kraal, Elm Road, New Maldon; Francis Alfred Drake, Rivington and Blackrod Grammar School, Horwich, Lancs; James Edward Ferguson, 26 Connaught Road, Stroud Green, N.; John Naish Goldsmith, Rock House, Tunbridge Wells; E. B. Hadley, The Green, Calne, Wilts; John Haworth, 4 Horsdon Terrace, Tiverton, Devon; Alexander Garden Hendry, 14 Avenell Road, London, N.; George William Fraser Holroyd, 14 Kensington Garden Terrace, W.; Walter Howe, 45 Spring Gardens, Bradford; Thomas Hill-Jones, Eagle Wharf Road, London; Reginald Arundale Kay, 7 The Causeway, Cambridge; John Charles Mascarenhas, 35 Harold Road, Upton Park; Thomas Arthur Nightscales, Tynemouth Street, Hull; William Pollard, Hitchin, Herts; John Armstedt Ray, jun., 15 Nassau Street, Dublin; Edmund Milton Rich, 7 Therapia Road, Honor Oak, S.E.; Gilbert Rigg, Tudor Villa, Bryn Road, Swansea; Henry John

Rolfe, 8 Powis Square, Bayswater, W.; Richard Seligman, 15 Queen's Gate Gardens, S.W.; George Senior, Arwendon, Abergele, North Wales; Samuel Smiles, jun., Fairoak, Beckenham, Kent; Benjamin Jordan-Smith, 42 King's Road, Reading; Basil Steuart, Broxburn, near Edinburgh; Ambrose Walton, Gledholt, Lower Broughton Road, Broughton; John Henry Young, 115 Birmingham Road, Oldbury.

The PRESIDENT said that before passing to the ordinary business of the meeting, he desired, on behalf of those present, to express condolence with the family of the late Mr. J. A. R. Newlands in their bereavement. It was not the occasion to refer to the work of Mr. Newlands in detail; everyone would recognise, however, that his name would always be associated with the progress of chemical thought in our time, and, happily, he had lived to witness the expansion of the idea contained in his law of octaves into one of the most comprehensive developments of modern chemical theory. As a tribute to his memory, it was proposed that an enlarged portrait of Mr. Newlands should be hung in the Society's rooms.

Of the following papers, those marked * were read.

***117. "Determination of the equivalent of cyanogen." By George Dean, B.A.**

An examination of the different values found for the atomic weight of nitrogen led to the attempt to deduce it in another way, viz., from the equivalent of cyanogen. A known quantity of dry silver cyanide, prepared by precipitation of dilute silver sulphate solution with dilute hydrocyanic acid, was dissolved in nitric acid, and the silver determined by finding what amount of pure potassium bromide was necessary for its complete precipitation. Stas's method of titration in a beam of yellow light was employed.

The weight of cyanide corresponding to the atomic weight of silver was thus found; subtracting from this the atomic weight of silver, the equivalent weight of cyanogen was obtained. The result of the experiments performed was to give a value of 26·065. Thus cyanogen is added to those substances, *e.g.*, chlorine, bromine, iodine, &c., whose equivalents have been observed by direct comparison with silver. If the value 12·01 is assumed to be the atomic weight of carbon, that for nitrogen, calculated from the equivalent of cyanogen, is 14·055.

DISCUSSION.

The PRESIDENT referred to the great importance of determining atomic weights by indirect methods. In conjunction with Dr. Scott, he had estimated the molecular weight of triethylamine hydrobromide

by titrating purified triethylamine with hydrobromic acid (*Proc. R. S.*, 1883, **35**, 347). The values obtained showed differences which were easily recognisable, the best determination giving 182·012, and the mean 182·089 for the molecular weight. This proved that triethylamine could not as yet be obtained sufficiently pure for the purpose of a determination comparable in accuracy with Stas's determination of the ammonium salts, but in spite of the relatively wide limits, it was possible to deduce the atomic weight of carbon from these values by a method entirely independent of the combustion of carbon as diamond, graphite, or carbonic oxide, on which all previous determinations of the atomic weight of carbon had been based. Thus, subtracting Stas's value for the molecular weight of ammonium bromide (98·032), the values for C_6H_{12} became 83·98 and 84·057 respectively, which lead to 11·981 and 11·993 as the atomic weight of carbon if Stas's value for hydrogen (1·008) be employed. Stas, curiously enough, had never deduced the atomic weight of hydrogen from his values for ammonium and nitrogen. The probable explanation of this was that he believed the deduced result, O : H = 16 : 1·008, to be far too high, being unable to reconcile it with the determination, O : H = 16 : 1, which Dumas obtained from the synthesis of water. If, however, the atomic weight of hydrogen be taken as unity, Stas's values for oxygen and nitrogen become 15·86 and 13·92 respectively, and it was to be remembered that, according to Lord Rayleigh, the densities of hydrogen and nitrogen were in the ratio of 1 to 13·898. Mr. Dean's experiments gave for the atomic weight of nitrogen a value slightly higher than this, and almost identical with that deduced by Stas for his synthesis of fused nitrate of silver. He hoped Mr. Dean would continue this important research.

***118. "The composition of American petroleum." By Sydney Young, D.Sc., F.R.S.**

An investigation has been made of the hydrocarbons in American petroleum boiling between, say, 25° and 115°, and evidence has been obtained of the presence of the following :—

Isopentane, b. p. 27·95° ; normal pentane, b. p. 36·3° ; pentamethylene, b. p. about 50° ; isohexane, b. p. about 61° ; normal hexane, b. p. 68·95° ; methylpentamethylene, b. p. about 72° ; benzene, b. p. 80·2° ; hexamethylene, b. p. 80·8° ; isoheptane, b. p. 90·3° ; normal heptane, b. p. 98·4° ; methylhexamethylene, b. p. about 102° ; toluene, b. p. 110·8°. Of these, the two pentanes and normal hexane have been obtained pure, normal heptane nearly so, and hexamethylene and isoheptane fairly pure. Miss E. C. Fortey, B.Sc., has obtained hexamethylene nearly pure from American and quite pure from Galician petroleum

(*Proc.*, 1898, **14**, 103). It is not improbable that other isomeric hexanes, and, therefore, possibly heptanes, may be present, and there are indications of the existence of small quantities of dimethylpentamethylene in American petroleum. A comparison of the results obtained with American, Galician, and Russian petroleum shows that the same classes of hydrocarbons—paraffins, polymethylenes or naphthenes, and aromatic hydrocarbons—are present in the petroleum from all three sources, but that the relative amount of naphthenes and, in all probability, of aromatic hydrocarbons is greatest in Russian and least in American petroleum.

***119. "The separation of normal and iso-heptane from American petroleum." By Francis E. Francis, B.Sc., Ph.D., and Sydney Young, D.Sc., F.R.S.**

The heptanes cannot be separated in a pure state from petroleum by fractional distillation, owing to the presence of naphthenes with boiling points not sufficiently far removed from those of the two paraffins.

A large quantity of mixed heptanes containing naphthenes, obtained by the partial fractionation of American petroleum, was therefore brominated. Heptyl and isoheptyl bromides were separated by fractional distillation under reduced pressure with a twelve column dephlegmator, and were reduced in alcoholic solution by a copper-zinc couple, a small amount of saturated hydrochloric acid being added. The reduced hydrocarbons were purified as far as possible, but the quantities, especially that of isoheptane, were too small to admit of satisfactory fractionation.

The boiling points and specific gravities of both paraffins were determined, also the critical constants of normal heptane, and its vapour pressures and specific volumes at a few temperatures. The data are compared with those for Thorpe's specimens of normal and iso-heptane.

***120. "The boiling points and specific gravities of mixtures of benzene and normal hexane." By D. Hamilton Jackson, M.A., Ph.D., and Sydney Young, D.Sc., F.R.S.**

In the fractionation of American petroleum from which the aromatic hydrocarbons have not been removed previously by treatment with a mixture of sulphuric and nitric acids, it is noticed that the benzene comes over chiefly at about 65°, the fractions above and below this temperature containing smaller and smaller amounts of it.

The approximate estimate of the amount of benzene is easily obtained by treating the fractions repeatedly with mixed nitric and sulphuric acids and diluting the acid with water. The dinitrobenzene separates after

some time in needle shaped crystals. The most probable explanation of the lowering of the boiling point of benzene appeared to be that aromatic hydrocarbons and paraffins, though miscible in all proportions, approximate in their behaviour to partially miscible liquids. The results obtained show that this is the case, for there is always expansion on mixing, and the boiling point of normal hexane is hardly raised by the addition of even 10 per cent. of benzene, whilst that of benzene is very rapidly lowered by adding hexane.

It is therefore impossible to separate pure normal hexane by distillation of any mixture of this paraffin with benzene, though it is easy to separate pure benzene from a mixture containing only a moderate amount of hexane.

***121. "The action of fuming nitric acid on the paraffins and other hydrocarbons." By Francis E. Francis, B.Sc., Ph.D., and Sydney Young, D.Sc., F.R.S.**

In the separation of pure normal hexane from American petroleum, the methylpentamethylene was removed by heating the nearly pure hydrocarbon with fuming nitric acid during several days. It was observed at the same time that the low boiling fractions, containing isohexane, were also purified by this treatment, and that, on diluting the nitric acid, considerable quantities of a trinitro-derivative of isohexane separated as a crystalline solid.

Other isoparaffins were found to react rapidly with fuming nitric acid when heated on a water bath, and to yield liquid or solid nitro-compounds, but the normal paraffins were attacked only very slowly, and, in these cases, the acid, when diluted, did not become turbid. Details are given of the action of fuming nitric acid on isopentane, isohexane, isoheptane, iso-octane, and di-isobutyl.

The behaviour of the paraffins, when heated with fuming nitric acid, is compared with that of other classes of hydrocarbons.

Discussion.

Mr. Groves asked to what extent olefines were present in petroleum.

Mr. Davis referred to Worstall's statement that normal hexane yields a considerable amount of the primary nitro-derivative when boiled with fuming nitric acid during a long period (*Amer. Chem. J.*, 1898, **20**, 202), and asked whether this had been observed by the authors, as such a method of purifying normal hexane would appear to be rather destructive.

Professor Young, in reply, said that the olefines present in American petroleum must be inconsiderable in amount, as very little bromine is

required to produce a permanent coloration; they would, of course, be eliminated during the treatment with mixed nitric and sulphuric acids.

With respect to the action of nitric acid, it must be remembered that the result is greatly influenced by the conditions, thus Konowaloff had shown that normal hexane and normal octane yield secondary nitro-compounds on heating with dilute nitric acid under pressure. Dr. Francis and he had found that the isoparaffins undergo nitration readily when heated with fuming nitric acid in a reflux apparatus on a water bath. The normal paraffins were much more slowly attacked under similar conditions, and as the nitric acid remained clear on dilution, it was evident that nitro compounds had not been formed from them in any appreciable quantity.

***122. "A composite sodium chlorate crystal in which the twin law is not followed." By William Jackson Pope.**

The author describes a composite crystal of sodium chlorate deposited from a pure aqueous solution. It consists of a cube-shaped crystal growing on to a tabular one; both crystals show the form {100}; a three-fold axis of symmetry of the one coincides in direction with a four-fold axis of symmetry of the other, and the plane (011) on the former is parallel to the plane (010) on the latter. The composite crystal is thus not developed in accordance with the ordinary twin law, and yet the two crystalline individuals have grown together in a highly symmetrical manner.

***123. "Stereoisomeric bromonitro- and chloronitro-camphors." By T. Martin Lowry, B.Sc.**

The action of nitric acid on bromocamphor and on chlorocamphor leads to the production of only one nitrobromo- and nitrochloro-camphor. The action of bromine and of chlorine on an alkaline solution of nitrocamphor yields in each case, however, a mixture of stereoisomerides, similar to that which is produced by the action of bromine on chlorocamphor (*Trans.*, 1898, **73**, 569). The stereoisomeric bromonitro- and chloronitro-camphors, isolated from this mixture, have the following melting points and specific rotatory powers :—

	M. p.	$[\alpha]_D$ (chloroform).
α-Chloro-α′-nitrocamphor	95°	−5°
α′-Chloro-α-nitrocamphor	132	+13
α-Bromo-α′-nitrocamphor	107	−22
α′-Bromo-α-nitrocamphor	106	+53

***124. "Camphoryloxime (camphonitrophenol)." By T. Martin Lowry, B.Sc.**

The so-called 'camphonitrophenol,' produced by boiling nitrocamphor with concentrated hydrochloric acid, is shown to be an oxime of camphoric anhydride, identical with that obtained by the interaction of hydroxylamine with camphoric anhydride. Its constitution is probably that represented by the formula $C_8H_{14}<\begin{matrix}C{:}N\cdot OH\\ CO\cdot O\end{matrix}$.

125. "The formation of ethereal salts of polycarboxylic acids." By S. Ruhemann and A. V. Cunnington.

The authors have found that the condensation of ethylic malonate and its homologues with the ethylic salts of unsaturated acids, leading to the formation of those of polycarboxylic acids, is readily brought about by adding a small quantity of sodium ethoxide (0·5 gram) to the mixture of ethereal salts. In a number of cases, the combination is accompanied by an evolution of heat, the intensity of which appears to depend on the negative character of the salts entering into reaction.

The preparation of a number of salts of polycarboxylic acids by this method is described, and the conclusion is drawn that in the same measure as the negative character is diminished by the introduction of an alkyl radicle into ethylic malonate or the ethylic salt of the unsaturated acid, so does the heat evolved in the reaction decrease.

126. "Note on the action of light on platinum, gold, and silver chlorides." By E. Sonstadt.

The action of direct sunlight on very dilute solutions of potassium chloroplatinate is similar to that of prolonged heating, platinum monochloride being separated, as described in an earlier paper (*Proc.*, 1898, **14**, 25). The action of bright sunshine is, however, slower and feebler than that of heat. Solutions of gold chloride, if sufficiently dilute, are more readily affected by light than corresponding platinum solutions. An aqueous solution containing about 0·04 per cent. of gold chloride required exposure to bright sunshine for a day or two before any action was perceptible, and the reduction was incomplete even after exposure during several weeks. A more dilute solution, containing 0·007 per cent. of gold chloride, became distinctly bluish after a few hours' exposure, and the blue coloration deepened day by day until a deposit formed, which was blue by transmitted light, and afterwards

assumed the usual brown colour of precipitated gold, the liquid being left colourless. A trace of hydrogen peroxide was detected in the liquid. The reaction may therefore be considered to be the same in this case as when a very dilute solution of auric chloride is decomposed by heat (*Chem. News*, 1898, **77**, 74).

It seemed probable that the action of light on silver chloride would, like the decomposition of platinum and gold chlorides in dilute solution by the action of heat or of light, depend on the presence of water and the formation of hydrochloric acid and hydrogen peroxide. Some silver chloride, precipitated from solution of silver nitrate by hydrochloric acid, was thoroughly washed by agitation with repeated portions of water, and decantation, the operations being conducted by feeble gas light, and then exposed under water to direct sunlight, with frequent agitation. After some days, the supernatant water was examined, and was found to contain a very appreciable quantity of hydrochloric acid, and to give a faint reaction for hydrogen peroxide. One of the two formulæ which will satisfy these conditions is $6AgCl + 4H_2O = 2Ag_2Cl + 2Ag + 2H_2O_2 + 4HCl$. But as silver, set free molecularly in presence of hydrochloric acid, would, on a reasonable presumption, form silver chloride with liberation of hydrogen, and as the nascent hydrogen would react on part of the hydrogen peroxide to form water, the equation, with these corrections, becomes $6AgCl + 4H_2O = 2Ag_2Cl + 2AgCl + 2HCl + 2H_2O + H_2O_2$. The same series of reactions would occur with the re-formed silver chloride and water, and it is obvious that, as, at each stage of the reaction, one-third of the silver chloride and one-half of the water are reproduced, and similarly with the hydrochloric acid and hydrogen peroxide, it follows that when the silver chloride taking part in the reaction is completely converted into argentous chloride, water will still be left as a permanent residue in addition to hydrochloric acid and hydrogen peroxide. This assumes that the silver chloride in a condition of accessibility to the influence of light is in the exact proportion to the water present indicated in the equation. But if the attackable silver chloride is present in a certain excess over that required by the equation, the end products of the series of reactions may be represented by the simple equation, $4AgCl + 2H_2O = 2Ag_2Cl + 2HCl + H_2O_2$, in which no residue of water appears. This is the second of the two possible formulæ referred to, and, it may be asked, what need is there to assume the complex reactions in series following from the first formula, when the second, which is so much simpler, satisfies the experimental results? There are, however, other experimental results of a singular character to be described, which may possibly be considered to be more easily intelligible on the supposition that the reactions are of the serial nature involved in the first equation.

Some silver chloride, precipitated and washed as already described, was dried for several hours on a sand bath, the temperature being raised progressively until the chloride became adhesive. Although the process was conducted under very feeble gas light, the chloride was sensibly discoloured. This discoloration is probably due to the same reaction taking place between moisture and the chloride under the influence of a high temperature as is effected by light in the cold. It appears that a higher temperature is needed for the reaction than that of water boiling at ordinary pressure, as the chloride is not discoloured by heating under water. A thoroughly dry and heated glass tube was nearly filled with the hot chloride, and immediately sealed. Another portion of the chloride was put into a bulb tube which had been previously dried and strongly heated, and was fused in the bulb. A slight, but unmistakable, trace of moisture condensed on the sides of the tube, showing that the chloride was not perfectly dry. The tube containing the (imperfectly) dried silver chloride was exposed to direct sunshine, when a bluish tint instantly spread over the chloride, deepening to a rusty brown, but leaving patches unaffected, so that, after long exposure, the fragments presented a mottled appearance with white spots on a dark ground. Evidently, portions of the chloride were really dry, though the bulk was not so, the dry portions resisting the action of light. Another tube, rather long and narrow, was similarly filled with the dried chloride, sealed, and exposed to sunshine with about half its length covered. The exposed portion of the chloride darkened as in the former case, with patches remaining unaffected. The covering was then shifted over the previously exposed part of the tube, with a like result; but the darkened chloride, now sheltered from light, became slowly bleached, until it was quite white. On again reversing the conditions, the bleached portion darkened, and the coloured portion was bleached, the same happening on each subsequent reversal. Even in the portion of the tube exposed to bright sunshine, the chloride on the under side became partially bleached, and on turning the tube round, the effect, after a few hours, was reversed. Dry silver chloride was then placed in the central part of a phial tube, and was protected by a little recently ignited asbestos from contact with fragments (placed in its lower and upper parts) of calcium chloride, and of caustic soda taken from sodium that had been long kept in a loosely closed bottle. The well-closed phial was kept in the dark during two or three days, to give time for absorption of moisture, and was then exposed to sunshine. The silver chloride became coloured, with white spots remaining unattacked, as in the former cases; but, on transference to a dark place, or on shading a portion, there was no bleaching. The coloration

remained practically constant in light and in shade. The bleaching effect, or the re-formation of argentic from argentous chloride under the conditions described in the former case, must therefore be attributed to a reversal in the dark of the primary reaction which takes place in the light; a reversal made impossible in the last-mentioned case by the absorptive action of the calcium chloride and the soda. Hydrochloric acid has no bleaching effect on light-altered silver chloride suspended in water, either in darkness or in light.

127. "Methanetrisulphonic acid." By Ernest H. Bagnall, B.Sc.

In endeavouring to prepare the various sulphonic acids and sulphones of dichlorobenzidine by the action of fuming sulphuric acid on dichlorodiacetylbenzidine, a substance was obtained which proved to be identical with methanetrisulphonic acid (Theilkuhl, *Annalen*, 1868, **147**, 134). This acid is also formed by a like process from diacetylbenzidine, acet-*a*-naphthalide, and acetanilide, the last giving a remarkably good yield of the substance. The silver salt crystallised in small, white, iridescent, monhydrated, orthorhombic plates, $a : b : c = 2{\cdot}9152 : 1 : 0{\cdot}5422$. The copper, barium, calcium, potassium, sodium, and ammonium salts are also described.

Attempts were made to prepare the corresponding sulphonic acids of ethane and propane by a similar process, but without satisfactory results.

128. "The nutrition of yeast." By Arthur L. Stern, D.Sc.

This investigation was undertaken to determine the amount of inorganic and nitrogenous nutriment required to produce the largest crop of yeast, the greatest assimilation of nitrogen, and the most complete fermentation in a fixed time. During the course of the investigation, other points had to be considered, of which the most important was the part played by sulphur compounds on yeast nutrition. The earlier work of Hayduck, who employed a different variety of yeast and a different variety of sugar, is referred to (*Zeitschr. für Spiritusind.*, 1881, 173).

The yeast employed was a pure form obtained from a Burton pitching yeast, the sugar was *d*-glucose, the nitrogenous nutriment asparagine, and the inorganic nutriment of two kinds: the first prepared from a yeast ash and free from sulphur, the second a mixture of potassium phosphate, magnesium sulphate, and calcium sulphate. Each experiment consisted in fermenting 500 c.c. of a 10 per cent. solution of the sugar, to which varying amounts of the nitrogenous and inorganic nutriment had been added.

It is shown that sulphur is an essential constituent of yeast nutriment, and that in the absence of other more suitable forms of sulphur nutriment, sulphates can supply the yeast with this element, a portion of the sulphate being invariably reduced to sulphuretted hydrogen. Attempts were made to find a substance of known constitution which could supply yeast with sulphur without the evolution of sulphuretted hydrogen, but without success.

It has been asserted that iron is an essential constituent of yeast nutriment, but no evidence could be obtained in support of this statement.

The author has examined the effect of variation in the amount of (1) nitrogen nutriment and (2) inorganic nutriment respectively on the amount of nitrogen assimilated, the percentage of nitrogen nutriment assimilated, the percentage of nitrogen contained in the yeast, the percentage of sugar remaining unfermented, and the weight of the yeast crop, and draws the following conclusion:—Any increase of nutriment beyond a definite limit will not materially increase the amount of nitrogen assimilated by the yeast, the percentage of nitrogen in the yeast, the weight of the yeast, or the amount of sugar fermented. This limit, called the normal supply, is the largest quantity that the yeast can assimilate under the conditions employed in the experiments, and is approximately 0·025 gram of inorganic nutriment per 100 c.c., and the same weight of nitrogen supplied as asparagine.

129. "The yellow colouring matters of Rhus Cotinus and Rhus rhodanthema. Part VI." By Arthur George Perkin.

Venetian sumach, the leaves of *R. Cotinus*, contains myricetin and not quercetin as stated by Löwe (*Zeit. anal. chem.*, 1874, **12**, 127). The leaves of *R. rhodanthema*, the yellow cedar of New South Wales, contain quercetin and gallotannic acid. The stems of both plants contain fisetin, and the leaves thus contain the more highly oxidised colouring matters, as quercetin and myricetin are considered to be hydroxy- and dihydroxy-fisetin respectively. Other members of the *Rhus* family hitherto examined contain no fisetin in the stem. The Venetian sumach examined contained 16·7 per cent. and the *R. rhodanthema* leaves 9·5 per cent. of tannin.

The leaves of *Artocarpus integrifolia* (Jackwood tree), *A. incisa* (bread fruit), and *A. lakoocha* are devoid of colouring matter.

130. "Colouring matters of the New Zealand dyewood 'puriri.'" By Arthur George Perkin.

"Puriri" (*Vitex littoralis*) is a large tree, growing in northern New Zealand, and chiefly used for building and similar purposes. Its

tinctorial properties are little known. It contains two colouring matters in the form of glucosides.

Vitexin, $C_{15}H_{14}O_7$ or $C_{17}H_{16}O_8$, the chief product, is a canary-yellow crystalline powder, distinguished by its sparing solubility in most solvents. Owing to the difficulty of obtaining substitution products without decomposition, its molecular weight is at present uncertain. *Acetylvitexin*, $C_{15}H_9O_7Ac_5$ or $C_{17}H_{10}O_8Ac_6$, forms colourless needles melting at 251—256°. On fusion with alkali, phloroglucinol, acetic and parahydroxybenzoic acids are formed, whilst boiling aqueous or alcoholic potash solutions give phloroglucinol and parahydroxyacetophenone. Further, the product of the ethylation of vitexin with boiling alcoholic potash yields paraethoxybenzaldehyde, paraethoxybenzoic acid, and a phloroglucinol derivative. Warm nitric acid (sp. gr. 1·54) forms metadinitroparahydroxybenzoic and picric acids, but when dilute acid is employed, a sparingly soluble *nitro*-compound, $C_{15}H_6O_5(NO_2)_4$, of unknown constitution, is also obtained in small quantity. This consists of small lemon-yellow needles, which dye mordanted calico; it is converted by strong nitric acid into picric acid, and appears to be closely related to vitexin. With nitrobenzene, it forms an addition product, $C_{15}H_6O_5(NO_2)_4,C_6H_5NO_2$, crystallising in orange-coloured needles which lose nitrobenzene at 150°, or by digestion with alcohol. Vitexin gives very pure yellow shades on calico mordanted with chromium and aluminium salts, but owing to its insolubility these are of a poor character. They somewhat resemble the corresponding shades given by apigenin, and as the chief decomposition products of both colouring matters are identical, it is probable that apigenin and vitexin are closely related.

Homovitexin, $C_{16}H_{16}O_7$ or $C_{18}H_{18}O_8$, is present in the wood only in minute quantity. It crystallises in fine primrose-yellow needles, melts at 245—246°, and is distinguished from vitexin, which it otherwise resembles, by its ready solubility in alcohol. Fusion with alkali gives phloroglucinol and parahydroxybenzoic acid, and treatment with dilute nitric acid yields metadinitroparahydroxybenzoic acid. It dyes mordanted fabrics feebly.

The shades given by "puriri" with chromium and aluminium mordants are distinguished by their pure yellow tone, and may have some commercial utility.

131. "Cannabinol." By T. B. Wood, M.A., W. T. N. Spivey, M.A., and T. H. Easterfield, M.A., Ph.D.

In former communications (*Proc.*, 1898, **14**, 66, 153) a number of derivatives of cannabinol have been described; a detailed account of these is given in the present paper. The oily lactone (*loc. cit.*, 153),

prepared from nitrocannabinolactone (oxycannabin), is shown to be a metatolylbutyrolactone, oxycannabin being the corresponding nitro-derivative. By the oxidation of cannabinolactone, a lactonic acid is produced, which on fusion with potash yields isophthalic acid.

Nitrocannabinolactonic acid is obtained by oxidising oxycannabin either by dilute nitric acid in a sealed tube, or by potassium permanganate.

The volatile fatty acids produced on oxidising cannabinol by nitric acid are shown to be normal butyric (Dunstan and Henry, *Proc.*, 1898, **14**, 44), normal valeric, and normal caproic acids, valeric acid being formed in the largest amount.

132. "Derivatives of hesperitin." By A. G. Perkin.

Hesperitin is found as the glucoside hesperidin in the citron, bitter orange, and other fruits of the same class. With potassium hydrate solution at 100°, it gives phloroglucinol and hesperitinic or hydroxymethoxycinnamic acid. It thus appears to have the constitution $OH\cdot C_6H_3(OMe)\cdot CH{:}CH\cdot CO\cdot O\cdot C_6H_3(OH)_2$ (Hoffmann, *Ber.*, 1876, **9**, 685; Tiemann and Will, *Ber.*, 1881, **14**, 948). With alcoholic potassium and sodium acetates, hesperitin gives the compounds $(C_{16}H_{14}O_6)_2,KC_2H_3O_2$, and $(C_{16}H_{14}O_6)_2,NaC_2H_3O_2$, which form colourless needles and decompose on treatment with boiling water, regenerating hesperitin. With sodium and potassium bicarbonates, *sodium hesperitin*, $C_{32}H_{27}O_{12}Na$, and *potassium hesperitin*, $C_{32}H_{27}O_{12}K$, are obtained, crystallising in minute, colourless plates. The formula of hesperitin is thus $C_{32}H_{28}O_{12}$.

Azobenzenehesperitin, $C_{32}H_{24}O_{12}(N_2Ph)_4$, forms red needles, melts at 246—247°, and yields a *diacetyl* derivative, $C_{32}H_{22}O_{12}Ac_2(N_2Ph)_4$, crystallising in ochre needles melting at 240—242°. Hesperitin should thus contain six hydroxyl groups, and this view of its constitution is confirmed by the formation of *acetylhesperitin*, $C_{32}H_{22}O_6Ac_6$, which crystallises in colourless needles melting at 127—129°.

If hesperitin were $C_{16}H_{14}O_6$, the constitution assigned by Tiemann and Will would thus be correct. Though not considered to be a polymeride of a substance of this formula, it must consist of two very similar groups linked together, as Hoffmann (*loc. cit.*) obtained from hesperitin a nearly quantitative yield of phloroglucinol and hesperitinic acid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Allen, A. H. Commercial Organic Analysis. 2nd Edition. Vol. IV. Proteids and Albuminous Principles, Proteoids or Albuminoids. Pp. ix + 579. London 1898. From the Author.

Attfield, John. Chemistry: General, Medical, and Pharmaceutical; including the Chemistry of the British Pharmacopœia. 17th Edition. Pp. xxii + 885. With 1 Plate and 4 Folding Sheets. London 1898. From the Author.

Beddow, F. First Stage. Inorganic Chemistry (Practical). Pp. viii + 165. London 1898. From the Author.

Briant, Lawrence. Laboratory Text-Book for Brewers. 2nd Edition. Pp. 356. With 5 unpaged Plates. London 1898. From the Author.

Briggs, W., and Stewart, R. W. Chemical Analysis, Qualitative and Quantitative. Pp. viii + 128. London 1898. From the Authors.

Dibdin, W. J. The Purification of Sewage and Water. 2nd Edition. Pp. xvi + 276. With 15 folding and unpaged Plates. London 1898. From the Author.

George, George. Practical Organic Chemistry. Pp. 96. London 1898. From the Author.

Jones, Chapman. An Introduction to the Science and Practice of Qualitative Chemical Analysis. (Inorganic.) Pp. viii + 213. London 1898. From the Author.

Landauer, John (trans. Tingle, J. B.). Spectrum Analysis. With 44 Figs. in the Text. Translated by J. Bishop Tingle. Pp. x + 239. New York 1898. From the Translator.

von Meyer, E. (trans. McGowan, G.). A History of Chemistry from Earliest Times to the Present Day. 2nd Edition. Translated by George McGowan. Pp. xxiii + 931. London 1898. From the Translator.

Patent Office Library, Catalogue of. Arranged Alphabetically. Vol. I. Authors. Pp. 1007. London 1898. From the Controller.

Pharmaceutical Formulas: A Book of Useful Recipes for the Drug Trade, collated chiefly from *The Chemist and Druggist* and *The Chemists' and Druggists' Diaries*. By Peter MacEwan. Pp. v + 664. London 1898. From the Author.

II. *By Purchase.*

von Georgievics, G. Lehrbuch der chemischen Technologie der Gespinnstfasern. II. Theil. Pp. ix + 354. With 47 Figs. in the Text. Leipzig 1898.

Storer, F. H. Agriculture in some of its Re[gu]lations with Chemistry. 7th Edition. 3 vols. Vol. I, pp. iv + 620; Vol. II, pp. iv + 602; Vol. III, pp. vi + 679. London 1898.

BANQUET TO PAST PRESIDENTS.

Fellows who have announced their intention to be present at the Banquet to Past Presidents at the Hôtel Métropole on Friday, November 11th, are informed that dinner will be served *punctually* at 7 o'clock.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December. Applications for grants, accompanied by full particulars, should be received by the Secretaries not later than December 5th. Forms of application can be obtained from the Assistant-Secretary, Chemical Society, Burlington House, W.

NOTICE TO AUTHORS.

As the *Proceedings* go to press on the Monday after each ordinary Meeting of the Society, the announcement of papers for the next Meeting cannot be made in this publication unless the papers are in the hands of the Secretaries by noon on that day.

At the next meeting, on November 17th, the following papers will be communicated:—

"Preparation of hyponitrite from nitrite through oxyamidosulphonate." By E. Divers, M.D., F.R.S., and T. Haga, B.Sc.

"Absorption of nitric oxide in gas analysis." By E. Divers, M.D., F.R.S.

"Interaction of nitric oxide with silver nitrate." By E. Divers, M.D., F.R.S.

"Preparation of pure alkali nitrites." By E. Divers, M.D., F.R.S.

"The reduction of an alkali nitrite by an alkali metal." By E. Divers, M.D., F.R.S.

"Hyponitrites: their preparation by sodium or potassium and properties." By E. Divers, M.D., F.R.S.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 24/11/1898

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 199. Session 1898–9.

THE BANQUET TO PAST PRESIDENTS.

The Banquet to the Past Presidents who have been Fellows for half a century:—

	Elected.	President.
Gilbert, Sir Joseph Henry, F.R.S.	May 18, 1841	1882-83.
Frankland, Sir Edward, K.C.B., F.R.S.	December 20, 1847	1871-73.
Odling, William, M.B., F.R.S.	January 17, 1848	1873-75.
Abel, Sir Frederick Augustus, Bart., K.C.B., F.R.S.	March 21, 1848	1875-77.
Williamson, Alexander William, LL.D., F.R.S.	May 15, 1848	1863-65. 1869-71.
Gladstone, John Hall, Ph.D., F.R.S.	December 18, 1848	1877-79.

was held at the Whitehall Rooms, Hôtel Métropole, on Friday, November 11th, 1898, Professor James Dewar, F.R.S., President, in the Chair.

The following Fellows and guests were present:—

Abel, Sir F. A., Bart., K.C.B., F.R.S.
Aikin, Dr. W. Arthur.
Allchin, Dr. W. H.
Allen, Mr. A. H.
Armstrong, Prof. H. E., F.R.S.
Atkinson, Dr. E.
Attfield, Prof. John, F.R.S.
Bailey, Mr. Henry.
Baker, Mr. H. B.
Barlet, Mr. S.
Barnes, Mr. G. C.
Barry, Sir J. Wolfe, K.C.B., F.R.S., *Chairman of Council, Society of Arts.*
Basset, Mr. Henry.
Beadle, Mr. Clayton.
Beale, Mr. W. P., Q.C.
Beilby, Mr. George, *President, Society of Chemical Industry.*
Bell, Mr. Chichester A.
Birdwood, Sir George, M.D., K.C.S.I.
Blagden, Mr. W. G.
Blount, Mr. Bertram.
Bloxam, Mr. A. G.
Borns, Dr. Henry.
Böttinger, Dr. H. T.
Bowley, Mr. J. J.

Brierley, Mr. J. F.
Brothers, Mr. Alfred.
Brothers, Mr. H. E.
Brough, Mr. B. H.
Brown, Prof. F. D.
Brown, Dr. H. T., F.R.S.
Brown, Prof. J. Campbell.
Brown, Mr. N. T.
Browne, Sir J. Crichton, F.R.S.
Brunton, Dr. T. Lauder, F.R.S.
Butt, Mr. E. N.
Burge, Mr. C. H.
Burgess, Mr. W. T.
Burne, Major-Gen. Sir Owen Tudor, G.C.S.I.
Calvert, Mr. J. H.
Cambridge University, Vice-Chancellor of.
Carpmael, Mr. A.
Carteighe, Mr. M.
Chattaway, Dr. F. D.
Clarke, Sir Ernest, *Secretary, Royal Agricultural Society.*
Clerk, Mr. Dugald.
Clowes, Prof. F.
Cookson, Mr. C.
Cooper, Mr. Albert.
Cooper, Mr. A. J. Bullen.
Cooper, Mr. H. Creemer.
Corfield, Prof. W. H.
Cousins, Mr. W. J.
Cresswell, Mr. C. G.
Crookes, Mr. Joseph.
Crookes, Sir William, F.R.S.
Crossley, Dr. A. W.
Dewar, Prof. James, F.R.S., *The President.*
Diamond, Mr. H. E.
Dibdin, Mr. W. J.
Dickins, Mr. F. Victor, *Registrar of the University of London.*
Dodd, Mr. T. H.
Donnelly, Maj.-Gen. Sir John, K.C.B. *Secretary, Science and Art Department.*
Duggan, Mr. T. R.
Dunstan, Prof. Wyndham, F.R.S., *Honorary Secretary.*
Dupré, Dr. A., F.R.S.
Dyer, Dr. Bernard, *President, Society of Public Analysts.*
Dymond, Mr. T. S.
Elder, Mr. H. M., *Secretary, Physical Society.*
Elliott, Mr. T. H., C.B., *Secretary, Board of Agriculture.*
Evans, Sir John, K.C.B., Treas. R.S.
Evershed, Mr. Frank.
Fairley, Mr. Thomas.
Fenton, Mr. H. J. H.
Festing, Maj.-Gen. E. R., F.R.S., *Director, Science Museum, S. Kensington.*
Fisher, Mr. E. H.
Fisher, Mr. W. W.
Formoy, Mr. J. A.
Forster, Dr. M. O.
Foster, Prof. G. C., F.R.S.
Foster, Prof. Michael, Sec. R.S., *President-Elect, British Association.*
Francis, Mr. G. B.
Frankland, Sir Edward, K.C.B., F.R.S.
Frankland, Prof. P. F., F.R.S.
Friswell, Mr. R. J.
Gardner, Mr. J. A.
Garwood, Mr. E. J.
Geikie, Sir Archibald, F.R.S.
Gilbert, Sir J. H., F.R.S.
Gilchrist, Mr. D. A.
Gladstone, Dr. J. H., F.R.S.
Goldsmith, Mr. J. N.
Goodwin, Mr. H. B., R.N.
Gowland, Mr. William.
Greenaway, Mr. A. J., *Sub-Editor.*
Griffith, Mr. George.
Grossman, Mr. E. H.
Groves, Mr. C. E., F.R.S., *Editor.*
Guttman, Mr. Oscar.
Hake, Dr. H. Wilson.
Haldane, Mr. R. B., Q.C., M.P.
Hall, Mr. S.
Hall, Mr. S. G.
Harbord, Mr. F. W.
Harley, Dr. Vaughan.
Harvey, Dr. J. Selwyn.
Hehner, Mr. Otto.
Henderson, Mr. G.
Hewitt, Dr. J. T.
Hibbert, Mr. W.
Hichens, Mr. J. H.
Hills, Dr. Hyde.
Hills, Mr. Walter, *President, Pharmaceutical Society.*
Holloway, Mr. G. T.
Hooper, Mr. E. Grant.
Howard, Mr. David.
Howard, Mr D. L.
Huggins, Sir William, K.C.B., F.R.S.
Huskisson, Mr. H. O.
Hutchinson, Mr. C. C.
Jackson, Mr. Herbert.
James, Mr. Alfred.
Jones, Mr. G. F.
Judd, Prof. J. W., C.B., F.R.S., *Dean, Royal College of Science, London.*
Kellner, Dr. William.
Kinch, Prof. Edward.
Kipping, Prof. F. S., F.R.S.
Kraftmeier, Mr. E.
Lawes, Mr. C.
Lawson, Dr. T. A.
Lewis, Mr. R. M.
Lister, The Rt. Hon. Lord, Pres. R.S.
Lundholm, Mr. C. O.
Lupton, Mr. S.
Luxmoore, Dr. C. M.
Macan, Mr. Hugh.
MacArthur, Mr. J. S.
Mac Ewan, Mr. Peter.

MacMahon, Major P. A., R.A., F.R.S.
Macnab, Mr. W.
Magdalen, Oxford, President of.
Mallet, Mr. F. R.
Masters, Mr. W.
Matthews, Dr. F. E.
McAlpin, Mr. K. W.
McLeod, Prof. Herbert, F.R.S.
Meldola, Prof. Raphael, F.R.S., *Foreign Secretary.*
Mercer, Mr. F.
Messel, Dr. Rudolph.
Miers, Prof. H. A., F.R.S.
Millard, Mr. E. J.
Milner, Mr. J. W.
Minchin, Prof. G. M., F.R.S.
Mond, Dr. Ludwig, F.R.S.
Moody, Dr. G. T.
Morgan, Mr. G. T.
Morley, Dr. H. F.
Morris, Dr. G. H.
Moulton, Mr. J. Fletcher, Q.C., M.P., F.R.S.
Müller, Dr. Hugo, F.R.S.
Muspratt, Mr. S. K.
Nathan, Major F. L.
Noble, Sir Andrew, K.C.B., F.R.S.
Odling, Mr. G. S.
Odling, Prof. William, F.R.S.
Ogston, Mr. G. H.
Ostwald, Prof. W.
Owen, Mr. J. F.
Page, Mr. F. J. M.
Perkin, Dr. W. H., F.R.S.
Perkin, Prof. W. H., jun., F.R.S.
Peterhouse, Cambridge, Master of.
Pickering, Mr. S. U., F.R.S.
Pilcher, Mr. R. B.
Ping, Mr. W.
Plimpton, Dr. R. T.
Prideaux, Sir Walter, *Clerk of the Goldsmiths' Company.*
Pullar, Mr. R. D.
Pye-Smith, Dr. P. H., F.R.S., *Senior Physician, Guy's Hospital.*
Ramsay, Prof. William, F.R.S.
Rayleigh, The Rt. Hon. Lord, F.R.S.
Reay, The Rt. Hon. Lord, G.C.S.I., *Pres. University College, London.*
Redwood, Mr. Boverton.
Renaut, Mr. F. W.
Rideal, Dr. Samuel.
Robbins, Mr. J.
Roberts, Sir Owen, *Clerk of the Clothworkers' Company.*
Roberts-Austen, Prof. W. C., C.B., F.R.S.
Robertson, Rev. Dr. A., *Principal of King's College, London.*
Ross, Mr. Callender.
Rotton, Mr. J. F., Q.C.
Rücker, Prof. A. W., Sec. R.S.
Russell, Dr. W. J., F.R.S.
Salamon, Mr. A. G.
Schweich, Mr. E.
Scott, Dr. Alexander, F.R.S.
Scott, Mr. E. L., *Clerk of the Salters' Company.*
Sheridan, Mr. M. J.
Slater, Mr. Charles.
Smallman, Mr. Alderman.
Smee, Mr. A. H.
Smith, Mr. C.
Smithells, Prof. Arthur.
Soper, Mr. A. L., *Secretary, City and Guilds' Institute.*
Spiller, Mr. John.
Spiller, Mr. William.
Sprengel, Prof. H., F.R.S.
Squire, Dr. W. S.
Steele, Mr. Robert, *Assistant Secretary.*
Stern, Dr. A. L.
Stevenson, Dr. Thomas, *President, Institute of Chemistry.*
Stokes, Sir G. Gabriel, Bart., F.R.S.
Strathcona and Mount Royal, The Rt. Hon. Lord.
Swan, Mr. J. W., F.R.S., *President, Institute of Electrical Engineers.*
Taverner, Mr. W.
Taylor, Sir John, K.C.B., *H.M. Office of Works.*
Terrell, Mr. H., Q.C.
Thomson, Prof. John M., F.R.S.
Thorne, Dr. L. T.
Thorp, Mr. W.
Thorpe, Dr. T. E., F.R.S., *Honorary Treasurer.*
Tilden, Prof. W. A., F.R.S.
Tookey, Mr. C.
Townson, Mr. T.
Travers, Dr. M. W.
Travers, Dr. W.
Trigger, Mr. O.
Turnbull, Dr. G. L.
Tutton, Mr. A. E.
Tyrer, Mr. Thomas.
Vincent, Mr. C. W.
Voelcker, Mr. E. W.
Wade, Mr. John.
Wade, Mr. J. L.
Webster, Sir Richard, Q.C., M.P., *The Attorney-General.*
Wheelwright, Dr. E. W.
Wightman, Mr. Charles.
Wilderman, Dr.
Williamson, Prof. A. W., F.R.S.
Williamson, Mr. O. K.
Williamson, Dr. Sidney.
Wilson, Mr. T.
Wood, Sir H. Trueman, *Secretary, Society of Arts.*
Woodward, Dr. Henry, F.R.S.
Wright, Mr. F. H.
Wynne, Dr. W. P., F.R.S., *Honorary Secretary.*

The following toasts were proposed :—

"Her Most Gracious Majesty The Queen."

The President: "My Lords, Venerated Presidents, and Gentlemen, —I have now the honour to propose to you the first toast. We are aware that the advancement of learning necessitates the possession of a peaceful environment, and that good sovereignty generates it. During the long life of Her Most Gracious Majesty the Queen, Science has developed by extraordinary leaps and bounds. But for the peaceful quiet the scientific man has enjoyed, that progress would have been impossible. Every scientific man therefore may acclaim with the poet 'She wrought her subjects lasting good.' Long may she rule over this great empire, beloved and revered of her people. I give you 'The Health of Her Most Gracious Majesty the Queen.'

"T.R.H. The Prince and Princess of Wales."

The President: "I have now the honour of proposing to you the second toast, the health of 'Their Royal Highnesses the Prince and Princess of Wales and the other Members of the Royal Family.' We know that His Royal Highness possesses in quite an exceptional degree two princely attributes, wisdom and prudence. We, as a nation, have recently had the opportunity of observing during the long time of trial that His Royal Highness has passed through, that he possesses another virtue, that of fortitude. I am sure that we shall all look forward with pleasure to his rapid recovery, and to his return to the discharge of those multifarious duties he performs so well. I am sure that the whole sympathy of the nation is extended to Her Royal Highness the Princess of Wales in the severe calamity that has befallen Her Royal House. I ought to mention that when this banquet was first proposed, a letter was sent from Marlborough House that expressed His Royal Highness's views with regard to the action of the Society. He said he would like to have honoured the distinguished chemists, especially Lord Playfair, 'one of my earliest friends,' by being present, had his engagements permitted it. Alas! since that time Lord Playfair has passed away full of honours and renown. The Society has thus lost its oldest President and its one remaining original member. I give you the health of 'The Prince and Princess of Wales and the other Members of the Royal Family.'"

"The Past Presidents."

The President: "I have now the honour to propose to you what you must all regard as a toast to which I cannot possibly do justice, the health of six of the most distinguished Past-Presidents of

the Chemical Society who for more than half a century have been members of that body. It is admitted on all hands that Chemical Science has added enormously to the resources and power of mankind, and that its successful cultivation involves the exercise of every faculty of the human mind. We have here six illustrious examples of successful scientific culture, and, I would add, of bracing moral influence; men whose one idea it has been, with steady aim and vigilant eye, to labour on with that sole incentive of scientific work, the triumphant hope of making an advance. These men have laboured for half a century in our interests, and they have added enormously to our knowledge of the science. It is almost impossible to realise the variety of the work they have done; the width of it is something appalling; when I tell you that, amongst them, they have recorded upwards of four hundred and fifty separate communications—how many there are that have not been recorded, I cannot say—and that among these four hundred and fifty there are many papers of the highest importance, I am sure you will agree with me that they have exercised a remarkable influence on the development of our science. It was well that the Chemical Society of London—the oldest Chemical Society in the world—should inaugurate this banquet. The Council felt that probably they might never again have the opportunity of calling together such a distinguished body of men as they have the honour of offering this banquet to to-night. We are still able to go back to a man, who sits on my right hand, who worked in the laboratory of Thomas Thomson, who has seen Dalton and the beginning of the Atomic Theory, probably the most wonderful of all the laws of Nature which man has ever been permitted to decipher. That being the case, the way in which the idea has been received by all the chemists of this country is apparent from the number of men of talent and the variety of classes here to-night. But beyond that, the sympathy of every chemist in the world is with us to-night at this banquet. The large number of congratulatory telegrams and communications that we have received to-day from every country where the science of chemistry is cultivated, will give some idea of the appreciation with which this banquet is regarded throughout the whole civilised world. We have received communications from France, Holland, Belgium, Germany, Sweden, Russia, Austria, the United States, and other countries. It is unnecessary for me to read every name, for every man identified with the progress of chemistry in every civilised country has responded by sending some form of congratulation. In every case they write as if they were present with us, as you will understand from the few illustrations I will give you of the sympathetic language they use. Professor Friedel writes: 'I should have been happy to associate myself with the Chemical Society in doing honour to these veterans of science. I have the honour to be the friend

of most of them, and the beneficent action they have exerted on Chemical Science cannot be esteemed too highly. They form the finest phalanx of the Fathers of our science which exists in any country. With these sentiments, you will understand the liveliness of my regret to be able to take part from afar and in spirit only in the honour paid them.' We have also received congratulations from learned societies both in Germany and Russia. At a meeting of the Russian Chemical Society the following resolution was passed: 'That the Society avail itself of the exceptional opportunity of being able to congratulate conjointly Sir Joseph Henry Gilbert, Sir Edward Frankland, Professor Odling, Sir F. A. Abel, Dr. A. W. Williamson, and Dr. J. H. Gladstone, whose distinguished services during half a century stand out as a model for all investigators in chemical science, and also express the wish to see the further results of their labours in the annals of science for many years to come.' The telegram from the German Chemical Society strikes me as very happy. Dr. Liebermann says: 'The sister Society sends both Jubilee congratulations and greetings to the Jubilee celebration of the Presidents of the Chemical Society, Gilbert, Frankland, Odling, Abel, Williamson, and Gladstone.' This shows, I think, that our Continental brethren appreciate the honour we desire to offer these distinguished men; and we need not be surprised that there is something more throughout these communications than mere cosmopolitanism in science. They breathe the spirit of friendly regard, of reverence, and even of love towards men who have done so much to advance the common cause of our science. How impossible it seems to sum up in any short speech the work that these men have done! If I attempted to classify them, I should say, that if we regarded them as twos and twos they would not group well together, but if we take three at a time, they bear somewhat close relations one towards another. I would say that Gilbert and Abel and Gladstone are monarchs of dependent kingdoms, whereas Frankland and Odling and Williamson are a triumvirate that have legislated towards the imperial side of chemical science.

"The work of Gilbert, as we know, was early differentiated into that most complex and mysterious study, the study of organic life. For the last fifty years he has devoted his attention to the physiology of plant life in every phase of its development. With a skill that has been unprecedented, he has recorded from year to year the variations in the growth of every kind of nutritious plant. He has examined into the meteorological conditions, the variations of climate, of soil and of mineral agents, of drainage, and of every conceivable thing affecting the production and development of plant growth. These memoirs are admitted throughout the world to be unique in their importance. Wherever the chemist or the physiologist, the statistician or the

economist has to deal with these problems he must turn to the results of the Rothamsted experiments in order to understand the position of the science of our time. These results will be for ever memorable: they are unique and characteristic of the indomitable perseverance and energy of our venerated President, Sir Henry Gilbert.

"The next among them, Sir Edward Frankland, I should characterise as one of the most remarkable experimentalists of this or any other age. He has been gifted with an absolutely unique faculty for experimental work and observation. The breadth and variety of his work is positively astounding. From early times devoted to the study of Organic Chemistry, he has branched out not only into Mineral Chemistry, but every form almost of applied industry. His early work on the organo-metallic bodies, so fertile in the way of future development, will be ever memorable. These bodies have been the means of adding to our knowledge of synthetical substances produced in the laboratory in a way that no other agencies have operated. Along with this work, he has executed investigations bearing on flame and the character of the light emitted by various bodies, and on a large number of questions connected with sanitary chemistry. His great work on the water supply of the United Kingdom, on the sewage question, and other industrial problems are generally acknowledged to be of great value and importance. Whatever work he has done is marked with the stamp of genius.

"The work of Odling has been an essential factor in the development of modern chemistry. It is characterised by precise and clear ideas, and an almost forensic ability for putting things in a straight, concise, and unembarrassing manner. His early labours in advancing the development of the newer chemistry deserve our warm gratitude, and his many published works and addresses on organic and inorganic chemistry, together with his translation of the work of Laurent, have all been of material service in diffusing a knowledge of our science. The papers he has contributed on Chemical Notation and on the question of types all display a marvellous precision as well as elegance of thought. Every one must admit the debt of gratitude we owe him for his iconoclastic labours in clearing out old and vague notions, and for the courageous manner in which he supported the newer ideas of his time.

"In the case of Abel, we have again a man who, at an early time, had his career differentiated for him. A distinguished student of Hofmann's, his early work was directed to organic chemistry, but he soon diverged into other channels, directing his attention to problems bearing on the chemistry of naval and military matters. We all know his splendid work on gunpowder, guncotton, detonation, and the whole field of explosive agents. Whether in connection with accidents

in mines, from petroleum, or from flour, dust or other agency, Abel has been a marvellous experimenter in the whole field of explosive chemistry. While engaged in these investigations in applied chemistry, however, he was adding to the advancement of pure science by the light which his researches threw upon many questions of chemical theory and by the stimulus thus given to further inquiry. He has had the great satisfaction of living through the age of gunpowder. That body had been the recognised explosive for many hundred years, and I have no doubt that when he commenced his investigations with Noble on gunpowder he never dreamt that he would live to see the day when he would clear out that smoky material and replace it before he left the War Office by a powder that is smokeless. I need hardly tell you that he has also added to our debt of gratitude by the personal services he has rendered to many learned societies.

"I come now to Williamson. The work of Williamson proclaims him a truly philosophic chemist. He has had probably the greatest satisfaction of any one I know. He cleared up one of the most intricate and recondite of chemical reactions, that with which we are familiar as etherification, and in so doing he struck at the very root of the chemical problems connected with atomic and molecular weights, and realised and cleared up for ever those mysterious modes of explanation which were undoubtedly faulty and insecure. Before his time, men as great as Berzelius, Mitscherlich, and Graham believed in that contact or catalytic action which in my early days bridged over the period between the old and the new, and was generally introduced when no other explanation was forthcoming. Williamson cleared all that away; but the discovery of these ethereal nepenthes did not act in chemistry as they would have done physiologically: they did not produce a soporific effect. They struck at the foundations of our science; and it is to his great credit that he originated advanced ideas, not only as to etherification, but as to molecular weights, type formulæ, and so forth. In fact the chemistry of our time would not be the chemistry of our time but for the work of Williamson. I would further add that he was one of the earliest to introduce the idea of dynamics into chemical science. His suggestion of the dynamical theory of the voltaic battery and of dynamic mobility in apparent stability has been exceedingly fruitful since his time; and if we add to them that most important and original idea of Frankland's, the saturation power of the elementary bodies, we have all the agencies of our modern scientific notions. One other debt of gratitude we owe to Williamson, and that is the interest he took in introducing into this country abstracts of all the important scientific memoirs published on the Continent. It is to him we owe those valuable abstracts which

have been printed for many years in the Chemical Society's Journal, and have done so much for the advancement of our science.

"Gladstone, on the other hand, represents a type somewhat different from that of any of the others that I have mentioned. He belongs to a characteristically English variety of men who have studied science for its own sake. Like Spottiswoode, De la Rue, and Joule, he has not been a professional scientist in the ordinary sense, but has worked out his long and brilliant scientific career as a labour of patient love. Furthermore, he has created an entirely new department—that which is in modern times regarded as physical chemistry, of which we have here to-night some distinguished representatives. For half a century he has worked on this side of chemistry, for his early investigation of the spectrum of the atmosphere was one of marvellous suggestiveness. He found that the spectrum of Fraunhofer varied at sunset and at sunrise from that at mid-day, and showed that a large number of those absorption lines must originate in the earth's atmosphere. That discovery stimulated further inquiry as to the substance that could produce these lines so characteristic of the solar atmosphere; and later experimenters have found it in the vapour of water and in oxygen. Gladstone's greatest merit, however, lies undoubtedly in his optical researches on the atomic refractions and dispersions of the elements. He has determined the optical constants of hundreds of bodies, and has thus stimulated inquiry in that borderland between physics and chemistry which is so much cultivated in the present day, and the pursuit of which has added so much to our knowledge. He has also contributed largely to miscellaneous inquiries, especially those connected with various voltaic batteries, and other questions conducive to the study of both organic and inorganic chemistry.

"This is but a brief epitome of the work of these great men. It would be, as I have said, hopeless for me to attempt to sum up all their individual labours. We can only skim the surface of the ocean of truth in which they have navigated so well and so successfully. But I will say this: that as experimentalists we are not likely to see their like again, and it is impossible to imagine a more extraordinary galaxy of chemical talent than these six Past-Presidents represent. They have rendered the science of chemistry more glorious for those who strive to follow; and the brilliant record of their discoveries can never be eliminated from the history of our Science. In the future, posterity will regard them as the most gifted and illustrious of the English chemists of the Victorian epoch. My Lords and Gentlemen,—I give you the health of our venerated Past-Presidents, Sir Henry Gilbert, Sir Edward Frankland, Professor Odling, Sir Frederick Abel, Professor Williamson, and Dr. Gladstone."

Sir J. Henry Gilbert: "After the extremely flattering and eloquent

terms in which our President has referred to the work of the six Past-Presidents of the Society who are so highly honoured to-night, it is surely a difficult task to say anything in response. I feel that any words of mine would be entirely inadequate; and I must, I think, fall back on what I was intending to say, and give a little personal history of the early times of the Society. You are aware, most of you, that I am to-night in the position of the senior of the Past-Presidents, in consequence of the death of Lord Playfair. He was, as you know, one of the founders of the Society, and, before he died, the only survivor of those founders. I myself came in within three months of the foundation, and so had some knowledge of the Society's early doings. In fact, before I was really admitted to the Society, under the influence of the late Professor Graham, I undertook the translation of a paper by Redtenbacher and Liebig on 'The Atomic Weight of Carbon'; and that paper occupies eighteen pages in the first volume of the Society's *Memoirs*. I should say that, less than a fortnight ago, I received a letter from Lady Playfair, just before she left to visit her friends in America, in which she said with what interest he had looked forward to being present at the banquet appointed for June—but that was not to be. I first made the acquaintance of Playfair in Liebig's Laboratory at Giessen, the year before the establishment of this Society, that is, in 1840. Playfair was at that time very busily occupied in translating the memorable work of Liebig, *Organic Chemistry in its Applications to Agriculture and Physiology*; and before the session was over he left for this country with Liebig, who was to present the substance of that work as a Report to the British Association at Glasgow in September. You may be interested to know who there were from this country in Liebig's laboratory at that time. Besides Playfair and myself, there were Dr. William Allen Miller, afterwards Professor of Chemistry at King's College; Dr. Stenhouse, who has contributed so much to the Journal of this Society; Dr. Angus Smith; and, lastly, Dr. Edward Schunck. He and I are, I believe, the only survivors of that time among those from England who were with Liebig then. Of the Germans who were there, some of the names you will probably remember. There were Heinrich Will, Varrentrapp, Redtenbacher, Hermann Kopp, Scherer, Bromeis, Boeckmann, and others, of various nationalities; but I believe that not one of these survives at present. Schunck joined the Society early in 1842, and he from that time to this has devoted himself to scientific investigation. He built a laboratory, and a museum devoted especially to specimens of organic bodies, in his own grounds on the other side of Manchester, where he still lives. He was, in fact, the oldest member of the Society, I believe, except Playfair and myself. He has worked indefatigably ever since; but I am very sorry to say he is not able to be here to-night, having had an

attack of bronchitis, which renders it impossible, though it would have given him great pleasure to be present. Referring to that time at Giessen, I may say that Playfair, Stenhouse, and myself, each took our degree then; and Playfair, though joining with us, having gone with Liebig, the responsibility was left with Stenhouse and myself to give the usual supper to the other students of the laboratory, and a few distinguished guests, among whom was Bunsen, who was then at Marburg; and who, I am glad to learn from Sir Henry Roscoe, is still well. Stenhouse was much my senior. We had a large and lively party, but Stenhouse did not enjoy that sort of thing very much, and when the last bottle of champagne was opened, he said: 'Now, Gilbert, I shall leave you to it,' and away he went. That was, however, not near the end of the evening. They stayed a very long time, and we did not exchange the smoky atmosphere of the supper-room for the clearer air outside until early morning. We then went round the boulevards of the little town, the Germans singing students' songs, and coming in time to the hotel where Stenhouse lodged, we serenaded him from the outside. Then someone tried the door, and finding it unfastened, the whole party went up, lighted candles, and serenaded him in bed. Next morning, there was a very capital caricature brought out, showing Stenhouse's rather long nose pointing in one direction, and his longer nightcap in the other. But this is enough of this kind of history, and I must now turn to rather more serious matters. It was in 1843 that I became associated with Mr. (now Sir John) Lawes, in agricultural investigation—a collaboration which has now extended over more than fifty-five years. As you all know, however rude may be some of the methods of the art of agriculture, the investigation of the principles underlying its practices involves a wide range of scientific inquiry. It involves the chemistry of the atmosphere, of the soil, of vegetation, and of animal life and growth. That is to say, besides chemistry, it involves meteorology, botany, vegetable physiology, and animal physiology, to some extent. It is impossible to be a specialist in so many subjects, particularly in these days, and I can only say that in venturing to deal with these other branches of science we have taken great care to avoid mistakes. The wide range of the investigations must be accepted as some explanation of the fact that we have not contributed more of the results to the Chemical Society. Many of them being connected largely with other branches of science, have been recorded in other than purely Chemical journals; whilst those having a more directly practical bearing have been published in the Journal of the Royal Agricultural Society, or in other agricultural publications—the Rothamsted papers now numbering considerably more than 100. But we feel that, however long or short may be the time that we shall still work together, we shall perhaps have done as much in opening up as in

solving problems; and that we shall certainly leave plenty for our successors to do. In conclusion, considering that there still remain five of your honoured guests to speak, this is all I will say of my own career, and I will only now ask you, Mr. President, the Council, and the Fellows of the Chemical Society, to believe that I esteem very highly the great honour you have conferred upon me to-night."

Sir Edward Frankland: "Allow me to thank you, Mr. President, and the Council of the Chemical Society for this delightful entertainment which you have prepared for the Past-Presidents who have attained Jubilee rank. It was a generous, unique, and happy idea, which I feel sure we all heartily appreciate, not only as we sit at your hospitable board, but also when we reflect on the kind feelings which led to the conception of that idea. There used to be a phrenological organ entitled 'love of approbation,' and whether there is or is not, a part of the brain told off to perform this function, I trust that chemists are not behind the rest of humanity in appreciating such an honour as you have conferred upon us on this auspicious occasion. Nothing could be more agreeable than thus meeting so many colleagues who are worthily keeping up the high reputation of the Chemical Society. There is but one drawback to our enjoyment, and it has been very feelingly alluded to by Sir Henry Gilbert, namely, that one who so recently stood at the head of our Past-Presidents should not still be present amongst us. In the lamented death of Lord Playfair, chemistry and science generally have sustained an immeasurable loss; for he was a binding link between science and the State, always ready to fight for the cause of truth against prejudice and ignorance, and never ceasing in his efforts to bring home to our rulers the vast importance of the applications of science to the progress, health and prosperity of the nation. As one of his first pupils, and after a life-long friendship, I may be permitted to testify that his energy in this cause was prompted by sincere convictions and not by political exigencies. Had Playfair lived a few months longer, we should never have had the misfortune to make the acquaintance of that new variety of *Homo sapiens* the 'conscientious objector,' who is just now giving so much trouble to our magistrates. This is not a time to sketch, even in merest outline, the epoch-making work of the Society, but I may at least state my conviction that it will be found, on comparing the volumes of our *Transactions* with those of the corresponding societies of other lands, that, considering the number of workers in each case, England is not behind any other nation in research work, and this in spite of the almost total absence of that lavish State aid which nearly every other civilised nation enjoys. In view of the vast number of discoveries pouring out from chemical laboratories, I hear it suggested that the day is not far distant when there will be nothing left to discover, when all the elements in the cosmos shall have been cap-

tured and fitted into the Periodic System of Newlands and Mendeléeff, when there is not one more gas in the atmosphere left to be detected, and every element and group of elements shall have its ortho-, para-, and meta-position assigned to it. What will then remain to be done? Fortunately for investigators, we shall still be only as children gathering pebbles on the shore of the great ocean of knowledge. As yet we have only found the big boulders. To change the metaphor, chemistry now occupies the position of geography a century ago. The enormous number of chemical compounds are like so many islands, their latitude and longitude ascertained with precision, but on which the foot of man has not been put down, whilst their animals, plants, and minerals have never been exploited. When the ideal state of knowledge has been attained, chemists will perhaps find time to explore this vast archipelago, in which, there is no doubt, many interesting discoveries await those who shall undertake the task. Who can set a limit to the usefulness of these explorations? Even the most unpromising compounds may turn out valuable prizes! When aniline, chloroform, and carbolic acid were discovered, who could have predicted the revolutions in the arts and surgery which these bodies were destined to produce! They were but as desert islands until they attracted the attention of Hofmann, Perkin, James Simpson, and Lister. As chemists, I believe we have a noble future before us. Chemistry is distinguished from all other branches of knowledge as the helpmate of nearly every other science. The geologist, the botanist, and the physiologist find no thoroughfare unless they call in the help of the chemist. As soon as the physicist breaks into a molecule, he is trespassing on our domain. The bacteriologist has found that it is not the waggling of the tail of a pathogenic microbe that is the most important feature of its history, but that the chemical compounds which it secretes demand his closest attention. Even the astronomer has already to sit at the feet of the chemist! Thirty-three years ago, when our worthy President was but a youth, there was once a dinner party composed chiefly of chemists held at the Albion. A few are still living—among them being Sir F. Abel, Prof. Odling, and myself. In an after-dinner speech on that occasion, my friend Abel is reported to have expressed himself in blank verse as follows: (I hope he will forgive me, at this distance of time, for appropriating his words to my own use).

"'Looking to right and to left, I see many faces around me,
Faces so old and familiar I feel once again at the College,
Testing, as in former times, for chlorine with nitrate of silver,
Gazing with youthful delight at crystals just hatched in a beaker,
Yearning o'er aniline drops distilling from crystal alembic.
O! my dear friends, one and all, we have toiled up a difficult pathway!
Some are low down on the hill, and others are near to the summit.
Let us remember the past and forget not our absent companions;
Fortune may come to us all; but youth will return to us never!'"

PROFESSOR ODLING: "I do not know that I can better commence the few observations I propose to make to you than by following in the wake of my predecessor, Sir Edward Frankland, and saying that it is no less a great pleasure than my bounden duty to express to you, Mr. President, and to the Council and Fellows of the Society my heartfelt thanks for the great compliment that you have paid to my colleagues and myself on this long-to-be-remembered occasion. Speaking, however, for myself personally, it is not the first time that I have had evidenced to me the kindly feeling of the Chemical Society. On the occasion of my retirement from the Secretaryship in 1869, I had also the special honour done me of being entertained at a dinner by the Society; and I also received a further token of their good will in the form of a capacious loving cup of no inconsiderable value in itself, but of far greater value as a perpetual mark of the kind feeling towards me of those with whom I had been for so many years so intimately connected. Those of us whom you entertain this evening have for a long period of time, as Sir Henry Gilbert and Sir Edward Frankland have already remarked, been associated with one another in common pursuits and enjoyments; and if there is one thing more than another that enhances to me the gratification of this meeting, it is the pleasure of finding myself associated still with my old friends and colleagues, Gilbert and Frankland and Williamson and Gladstone, and my earliest friend of all, Sir Frederick Abel. We have been concerned with one another in a large number of undertakings, and for a long period of time have been accustomed to hear one another's voices as well upon festive as upon scientific occasions. But we have not been accustomed to hear them in exactly the order they have been arranged for this evening. I have always looked upon myself, not as a precursor, but as a follower of Williamson. It has been my pride to reckon myself one of his adopted pupils—a disciple of his ideas more perhaps than many of those who were his actual pupils. He was always very decided in his notions. Sometimes, indeed, I turned a little restive, but was always soon pulled up into form again—sometimes more abruptly, perhaps, than was quite agreeable at the moment. At one time I laboured under the sad suspicion of being a little unsound as to the Atomic Theory. Well, perhaps I was not altogether so stalwart in its defence as I ought to have been; but I can assure you that I was never really guilty of so reprehensible a heresy as that which was attributed to me.

"You are doing us honour here this evening not so much, or not only, as students of the science of chemistry, but also as Past-Presidents of the Chemical Society. As ancients of that Society, we may all of us perhaps be permitted to talk a little about ourselves without incurring the imputation of egoism, and also to talk a little about old times without incurring the reproach, after our fifty years' fellow-

ship, of senile garrulity. At the period during which I acted as one of the Secretaries of the Society, and my colleague, Professor Redwood, concerned himself mostly with the business department of our affairs, the Chemical Society had not developed very far its function as a publishing agency, and as a consequence, even for that little prolific time, we did not get our fair share of important papers communicated at first hand to our meetings. But if we did not receive elaborate communications, we enjoyed the benefit of elaborate discussions; and there was no new class of compounds, no newly propounded doctrine, no new reaction which was not submitted to our keen examination and controversy. The subjects of several of those controversies, and even the fashion of them, still linger in one's memory. I need scarcely say that chemical theory came in for a large share of our attention. The molecular weights of water and carbonic acid, the atomic weights of oxygen and carbon, and, above all, the then newly introduced idea of polyatomic radicles were keenly discussed. We were a little too late for the interesting question as to whether compound radicles could possibly be oxygenous; but still, radicles were predominant at that time in chemical science, and reigned with undisputed sway over the whole domain of organic chemistry. One cannot but reflect how fleeting has been their reign. The doctrine of radicles has now sunk to an entirely subordinate position in chemistry, not unlike, may I venture to say, the subordinate position into which radical doctrines have fallen in a different sphere. There was one particular controversy I remember very well, and am sure Frankland will remember also. It was of this kind: whether the bodies called ethyl and methyl were really ethyl and methyl at all, or something else. Well, a question of that kind in those unsophisticated days had to be answered definitely by a plain aye or no. There was no loophole for escape or trimming, no possibility of saying that the one answer was just as true as the other, according to the point of view taken; nor was there existent in that period of innocence, for the solution of yet more puzzling problems, what we know now by the name of tautomerism, by which we learn that a body is, and at the same time is not, what it is alleged to be; that it is sometimes one thing and sometimes another, and sometimes both together, and yet preserves its individual chemical entity. In those days the principal provider of chemical material for our meetings was far and away Hofmann. He was in the habit of sending his multitudinous papers to the Royal Society for publication; but he gave us the advantage of his presence and his personal disquisitions; and I would appeal to all in this room who had the advantage of seeing him, to say if they can possibly forget his appearances at

the blackboard of the Chemical Society, and the enthusiasm and lucidity of his expositions of different points of chemical constitution, enlivened as they were by that extraordinary display of vivacity so inconsistent with the quiet phlegm we are in the habit of attributing to those of his nationality. But, despite the productiveness of Hofmann, still there were evenings on which something else was required; and then it behoved the Secretary to search far and wide for material to bring before the meeting of chemists who, with Greek-like avidity, were always clamorous for 'some new thing.' At that period, the activity of the Giessen school was somewhat on the decline, and we looked for novelties in chemistry, as for novelties in mantles and millinery, to Paris. We had for our consideration the acidic ammonias of Gerhardt and the diatomic glycols of Wurtz, and the production of alcohol without the aid of either sugar or yeast by Berthelot, and many other remarkable contributions to the knowledge of the day. But our friends across the water, with so much—so very much—justly due to them, nevertheless did manifest now and then a tendency to appropriate to themselves what did not altogether belong to them; and in this, the country of Black and Priestley and Cavendish and Dalton and Davy, we were astonished one fine morning at being informed that 'la Chimie est une science française.' But even with the productiveness of Hofmann and the searchings of the Secretary, it did sometimes happen that our bill of fare was a little meagre. But what of that? Those were supper-eating days, and a meeting rendered brief by want of pabulum could always be supplemented by a prolonged and substantial, and, I may add, a musical, meal at a then well-known resort not far from Covent Garden; and when it happened, as it did sometimes, that our proceedings were not so exhilarating as they should have been, when divine philosophy had proved less charming than its wont, Hofmann, despite the abundant supply of tea and coffee of excellent quality, would, with a burst of inspiration, thrust forth his right hand and say: 'I will tell you, we will have a punch!'

"But the Chemical Society has a future to look forward to, as well as a past to look back upon. At the Jubilee of the Society some seven or eight years ago, it devolved upon me to give an account within the short period of a quarter of an hour—I believe I occupied twenty minutes—of the progress of chemical science during the preceding fifty years. But to-day is also a Jubilee or almost so, the Jubilee of our incorporation by Royal Charter, which, in the then days of our insignificance, Playfair did so much to obtain for us. Now, on this diamond Jubilee, I ask you how many minutes will you give me to lay before you a forecast of the chemical progress that may be expected to take place within the next fifty years? I will only venture to say that,

judging by the number and activity and intellectual gifts of the workers of the present day, we may feel assured that the achievements of English chemistry and the progress of the Chemical Society in the past, will be as a mere nothing to the brilliancy to which they will attain in the future."

Sir Frederick Abel: "Sir Edward Frankland has out of his vast stores of knowledge recalled a fact of which I confess I was ignorant, that in years past I indulged a poetic fancy. I only wish I might now be inspired in order to find words to express on behalf of myself and my old friends our appreciation of this glorious reception which you have given us. The Chemical Society is endeared to me in many ways. Among the epochs of a somewhat long career of ceaseless activity, that which connected me intimately with the work of the Society is one of those which I recall with the greatest pleasure and satisfaction. And it so happens that the years of my connection with the Society in various functions were years in which some of the most memorable events in its annals occurred. As Treasurer, it was my privilege to arrange with the illustrious chemist and brilliant orator, Jean Baptiste Dumas, for the delivery of the first of those memorable lectures which were given through the agency of the Chemical Society in honour of the memory of Michael Faraday. While I was Treasurer, the volume of the Journal of the Society, which was then of modest and slender dimensions, nurtured by well digested extracts from foreign journals, speedily gained proportions unwieldy in character, so unwieldy, in fact, that the one volume split up into two before long. In the first year of my Presidency, the Research Fund, which was initiated in a modest manner by Mr. Thomas Hyde Hills, was placed upon a firm and substantial basis through the generosity of one of the most respected of the Society's original members, Dr. Longstaff; and in the second year in which I held that office, the somewhat revolutionary agitation which was persisted in by a not unimportant section of the younger Fellows of the Society,—an agitation which, by the way, has been imitated since—led to earnest deliberation and consultation between the Council and some of its chosen members outside the Council, which resulted in the birth of an institution now flourishing exceedingly, which has become the guardian of the best interests not only of the chemical profession but also of the public. I of course allude to the Institute of Chemistry of Great Britain and Ireland. When I look back to the early days when I first owned the proud title of F.C.S., and remember my attendance, in a small room at the Society of Arts, at the meetings of the Chemical Society, presided over in succession by William Brande and Phillips, the business being managed by

George Fownes and Robert Warington, the founder of the Chemical Society, and the funds not very cleverly handled by dear old Robert Porrett, one of the most prominent forms that appears in my mind's eye is that of the favourite pupil of Liebig, my venerated master, Hofmann. In the very first years of the Society, Hofmann became the very life and soul of it. He was beloved by his English brethren directly he came among them, and for years he was by far the most prolific contributor, either himself or through his pupils, to the volumes of the Society. Pardon me if I have been tempted into reminiscences; it is difficult to avoid it at such a gathering as this. The welcome you have given to the veteran Past-Presidents will remain in their minds to their last day as one of the great joys of their lives. To the many old friends and colleagues whom I see around me—Past-Presidents who, as men of science, hold positions second to none, whose names are familiar as household words—to them I can wish no higher gratification than that they may live to experience the satisfaction of such an entertainment, and of such a graceful appreciation of their work, as has been the lot of your old Past-Presidents to-night."

Professor A. W. Williamson: "I thank you, Mr. President, most heartily for the kindly words you have uttered in relation to me, and to my efforts for the advancement of chemistry. It is an immense satisfaction to me to see a man of your talents and vast acquirements placed in so influential a position as that which you so worthily occupy. But whilst thanking you I am bound to confess that I have been for some time past a most unworthy member of the Chemical Society. It happened that after a good many years of work in our Society, I had other matters of such importance claiming my time and attention, that I was unable to continue to work amongst my colleagues and friends in the Chemical Society.

"Before I came over in 1849 to work at University College, I had become acquainted in the Giessen Laboratory with that most remarkable man, August Wilhelm Hofmann, and I may mention a characteristic incident illustrating his earnest and steadfast devotion to his science. He had for a considerable time been working at derivatives of aniline, and in order to carry on these researches as effectively as possible, he prepared by the action of caustic potash on indigo about some two gallons of aniline. The product was placed in a big bottle on the mantelpiece in his bedroom, and the story goes that he used to stand and gaze at it for some time every morning and evening, and gloating over it with delight would think, 'what a number of splendid products I shall make out of this aniline!' The energy and devotion with which he followed up his work on the derivatives of aniline at

the expense of many other researches which he might with advantage have followed up was such that he came to be talked of as the great worker on aniline, and Sir Benjamin Brodie somewhat prematurely wrote his epitaph in the following words, 'Hic jacet Aniline.' His researches extended, however, at an increasing rate into other and wider departments of chemistry, and his energy and enthusiasm were such as to make him the leading explorer in the domain of organic chemistry. Berzelius had been for a lengthened period the one great man in the domain of inorganic chemistry, which was the only part of the science which had been explored to any appreciable extent. When I saw the vast piles of knowledge which Hofmann was so rapidly accumulating in the new domain of chemistry, I felt, and ventured to say, that his masterly labours entitled him to be called the Berzelius of Organic Chemistry. I happened to be present at a meeting of the Chemical Society at which a young chemist read a paper in the presence of Hofmann on some theoretical matters of importance which had already engaged the attention of distinguished chemists. Hofmann did not enter into any particulars of the paper, but he gave vent to an outburst of heartfelt delight at the simple narrative which had been read. There are various incentives to work, but the most potent incentive to earnest and efficient work is probably the example of a man like Hofmann, whose whole delight lay in mastering the truths of science, and in learning more and more particulars of the order of nature, and Hofmann possessed that power in a most eminent degree.

"We see in this grand hall an assemblage of chemists known by their earnest labours and valuable discoveries, and we are honoured by the presence of men of the highest distinction in other branches of science, as well as of leaders in the learned professions. It might not be unreasonable to believe that enthusiastic delight in the triumphs of chemical research is duly represented by some of the guests in this hall, and that the lively conversation which has been going on may not relate merely to high questions in jurisprudence, medicine, or legislation, but that some samples of chemical enthusiasm may reach the ears of the learned representatives of other professions.

"I feel sure that at a future time we shall all look back with the highest pleasure upon this delightful evening, which we owe to the kindly exertions of our President and other leading members of the Society."

Dr. John Hall Gladstone: "It is a pleasant thing to look on the faces of so many friends with whom one has worked in olden times, with whose works one is well acquainted; though, of course, there are many at the present time who come into the Society, and whom I can look to as budding philosophers: unfortunately, I do not know their

names so well as their faces. The pleasure is not merely because we call ourselves chemists, but because there is a bond of union between us arising from the desire of discovering the wonderful secrets of the great cosmos of which we ourselves form part. There is a great difficulty in speaking to you this evening, because so much that I should have liked to say has already been said by previous speakers. Still there are one or two things which, if you will permit me, I should like to bring before you. First of all, in your too flattering description of myself and of my work—which makes me rather ashamed to stand up and speak—there was a point which I think calls for remark, and so I must venture upon that which characterises the speeches of all of us, a certain amount of early autobiography. I was exceedingly fond of science from a little child. My favourite science was geology, and also what could be seen in the microscope—infusoria, and other little objects we have heard of in later times. But, in choosing a profession, my father said geology was not a promising career, and recommended chemistry. I knew very little about it, but went to University College and studied under that admirable teacher, Professor Graham, and afterwards under Liebig. I suppose it was from Graham that I acquired the taste for the physical side of chemistry and its connection with heat, light, electricity, and other forces of nature. I looked out for a scientific position, and lectured at St. Thomas's Hospital for some time, made analyses, and considered myself a professional chemist. It may be that circumstances have caused me to sink into the position of an amateur chemist, but my first intention was that of following chemistry as my profession in life. It has not been necessary to continue that; and I have had this advantage, that I could always keep in my laboratory a good, trained assistant, and thus, whilst I was engaged in other works and ways, and in endeavouring to extend the knowledge of chemistry and elementary science in our primary schools, the work still went on more or less under my immediate direction. I should like to have said something about the progress of chemistry during these past fifty years; but the subject is so enormous, and you yourself have touched upon it to such an extent and so well, that I need only allude to the fact that this great change of volume of chemistry has caused it to be necessary that we should specialise. Specialisation has its advantages, but also its disadvantages. One danger is that we may become narrowed in our views. So it would appear to be best to have a home somewhere or other, but to make occasional excursions in the neighbourhood, and take summer holidays so as to get our nerves braced up to work again at our own pet subjects. I must not touch upon other points, such as the relations of the physical forces to

chemistry, or its useful applications, and the great value of chemical research for the welfare of mankind. These are subjects too large and important to enter upon at this late hour. It seems to me that while we are always increasing the mass of knowledge we possess, the space which we see to be bright becomes larger and larger, but there is beyond a dim nebulosity. It is our work to bring from that nebulosity something into the bright space, so that it becomes the property of the human race. But there is beyond this a region which we do not understand—infinite as far as we know—and our object is to increase that which is knowable, in the firm belief that it will be for the advantage of our fellow creatures. While I feel thankful for the joy that I have had in taking some part in these discoveries, I cannot look to have much more time given me for carrying on this work of investigation; but still there may be a few threads of old research I may gather up, and in doing so I shall be greatly encouraged by the kind remarks of this evening and the way in which our work has been received by the friends gathered around us."

"The Foreign Members."

Sir William Crookes: "If it is possible for an after-dinner speaker to associate the word pleasure with the duty he has to perform, then I may lay claim to a slight feeling of that kind; for we are here assembled to do honour to our Past-Presidents, who are, as it were, now celebrating their jubilee in the Chemical Society. But it so happens that I also have a little jubilee of my own at this time, for exactly 50 years ago I made my first step in science by entering the Royal College of Chemistry. I remember as if it were yesterday, on a dull November morning, being introduced to Hofmann, who forthwith installed me at a bench, and asked Spiller, who was a few weeks my senior in science, to put me through the gases, preliminary to a course of the 'Giessen Outlines.' These were the days of compound ammonias, and heating in sealed glass tubes under pressure; having a certain facility at the blowpipe, I used to seal up some of these tubes; many of them, I fear, burst, for I well remember Hofmann's quaint remark, while watching one of them with anxious eyes, 'I think, Mr. Crookes, it will now gradually commence to explode violently.'

"One of the great troubles of a long life is to see the friends of early days drop off one by one. Of those in the College when I entered, I know only of Abel, Buckton, Dent, Spiller, and one or two others. It is a special pleasure for me to be here to-night and join in doing honour to one of these—my oldest scientific friend—Sir Frederick Abel. But in these reminiscences I must not forget my duty. I am

asked to propose the health of the Foreign Members of the Society. There is a little topsyturveydom about this arrangement. I am saddled with a burden to which I have only a doubtful right. Such a toast can only be proposed by a Fellow, but when, some time ago, I approached your senior Secretary in that capacity, he refused to regard me in this light, and said I could only dine among you as a visitor.

"But the occasion is so special that, as a visitor, outsider, or Fellow, it must always be a great pleasure to propose the toast of the Foreign Members. We have a large roll of Foreign Members on our list. They are very eminent men; and, as proof, I need only mention that on this special occasion they are so busy with scientific work that few are able to come to join us to-night. But we have amongst us one of the most eminent of Continental chemists—Professor Ostwald—whose name is a household word to us all, and I will ask him to take the burden of replying to this toast."

Professor Ostwald: "The task laid upon my shoulders is so heavy that I cannot bear it in a foreign language. I must ask you, therefore, to allow me to answer in my own. Als ich die ehrenvolle Einladung für den heutigen Tag erhielt, war ich sofort bereit zu kommen. Nicht weil ich eine grosse Zahl guter Freunde und werthvoller Dinge in London sehen konnte; ich kam um eine grössere Sache. Ich kam, um Zeugniss abzulegen von der Gemeinschaft der wissenschaftlichen Männer aller Nationen. Das Fest, welches Sie feiern, hat seinen Anklang in der ganzen Welt gefunden; die wissenschaftliche Internationalität bringt es mit sich, dass des heutigen Tages überall gedacht wird, wo Chemiker sind.

"Meine Herren! Die Wissenschaft ist ein Land, welches die Eigenschaft hat, um so mehr Menschen beherbergen zu können, je mehr Bewohner sich darin sammeln; sie ist ein Schatz, der um so grösser wird, je mehr man ihn theilt. Darum kann jeder von uns in seiner Art seine Arbeit thun, und die Gemeinsamkeit bedeutet nicht Gleichförmigkeit. Wir werden immer an unseren französischen Arbeitsgenossen die Klarheit ihrer Darstellung und die Strenge ihrer logischen Entwickelung bewundern. Die Originalität der Gedanken und die unwiderstehliche Energie ihrer Durchführung wird stets die englische Forschung auszeichnen, und wenn wir Deutsche 'durch die Welt mit allen Sinnen schweifen,' um für unsere Arbeit eine möglichst breite Unterlage und einen möglichst weiten Horizont zu gewinnen, so thun wir darin auch nur, was unserer Natur entspricht.

"Hierzu möchte ich aus unserer Wissenschaft ein Beispiel entwickeln. Es ist ein wichtiges Resultat der heutigen Forschung, dass es nicht möglich ist, einen absolut reinen Stoff herzustellen. So rein er auch wird: die letzten Spuren seiner Mutterlauge können

nicht entfernt werden, und er trägt immer ein Zeugniss seiner letzten Geschichte mit sich.

"Nun, meine Herren, in der Chemie des Geistes gilt ein ähnliches Gesetz. Auch der klarste Gedanke, die durchgearbeitetste Theorie trägt Spuren der Umgebung mit sich, aus der sie entstanden ist. Wenn nun der Fremde den neuen Gedanken zum ersten Male zu Gesicht bekommt, und er gefällt ihm nicht, so wird er sich zunachst nicht bewusst sein, ob der abstassende Eindruck von dem Gedanken selbst, oder von der anhängenden Mutterlauge herrührt, und es kann kommen, dass er ihn verwirft, nicht wegen seiner eigenen Beschaffenheit, sondern wegen zufälliger Beimengungen. Wenn ihm aber jenes *Gesetz der geistigen Mutterlauge* bekannt ist, so wird er sorgfältiger prüfen, und manches Vorurtheil, welches die gemeinsame Arbeit der Nationen stört, wird fallen.

"Für diese Gemeinsamkeit bietet gerade der heutige Abend einen ausgezeichneten Beleg. Als ich die Geschichte meines besonderen Gebietes, der Verwandtschaftslehre studirte, fand ich aus sehr früher Zeit eine Reihe hochwichtiger Arbeiten, durch welche eine Anzahl fundamentaler Thatsachen festgestellt wurden. Die Arbeiten trugen den Namen des Dr. Gladstone. Ich habe vergeblich darauf gewartet, dass heute Abend diese Arbeiten erwähnt würden. Es ist nicht geschehen, und ich glaube, Dr. Gladstone hat selbst vergessen, dass er sie gemacht hat. Aber wenn er sie auch selbst vergessen hat, die Wissenschaft wird sie nie vergessen. Und wenn jetzt, nach soviel Jähren, die Wissenschaft in Schweden, Holland, and Deutschland den Faden dort weitergesponnen hat, wo Dr. Gladstone in England ihn aus der Hand gelegt hat, so haben Sie ein schlagendes Beispiel vor sich, wieweit über Raum und Zeit die wissenschaftliche Gemeinsamkeit aller Forscher reicht."

"The Learned Societies."

Lord Reay: "I have seldom had the honour of proposing a toast to so distinguished an assembly, and at the same time a toast which, whether it was proposed at St. Petersburg, at Berlin, in Paris, in Vienna, or in Rome, coupled with the names with which it is coupled to-night, would attract the same applause. Lord Lister has conferred on the House of Lords, in entering it, an additional dignity. If we are asked—and we are occasionally asked—why there is a House of Lords, I do not know that we can give any better answer than by saying that the House of Lords is the proper place for receiving the princes of science. And, gentlemen, among the characteristics of the House of Lords there is one to which I shall allude; one which I consider a very important characteristic. If I ask what are the characteristics of the House of Commons—what are the characteristics of those

who wish to enter the House of Commons,—then I am told that the catechism to which one has to answer is: 'Are you sound on Labour?' Now I am not quite sure that I fully grasp what is meant by soundness on Labour. But the problem may be solved when the House of Commons approaches a task which I know would tax the efforts of all the learned societies in London to deal with—the question of old age pensions. What is the catechism of the House of Lords? I think the question would be: 'Are you sound on Science?' I believe the House of Lords is sound on science, and in the contests of the future between prejudice and the laws of science, I think you will find, as you have found in the recent debate on vaccination, that the House of Lords will be on the side of Science, and not on the side of prejudice. And if the House of Lords is to remain sound on Science, then it will be due to having in its midst men like my noble friend, Lord Lister, to keep it straight whenever it may show any inclination to diverge from the dictates of Science. There is hardly any subject at present in any department of the public service in which the question of science does not play a prominent part. And I do not believe that there is any department of the public service which does not occasionally seek the aid of a learned society on one or other of the scientific problems it has to solve. My late distinguished friend, M. Léon Say, used to predict of the twentieth century that Cabinets would be formed on the basis of sanitation. If so, we may still hope to see my noble friend, Lord Lister, at the head of the Home Office.

"With this toast is also coupled the name of my friend Professor Michael Foster. Mr. President and gentlemen, it is to me personally a great pleasure to couple with this toast that name, because the future of scientific education in London is committed to the care of Professor Michael Foster. The Statutory Commission, I hope, will set at rest that interminable controversy about the reconstitution of the University of London, and to Professor Michael Foster will fall the duty of settling the future of Science in that institution, which will influence the future of Science in our great empire. Let me conclude with an observation, which is the result of what fell from the eloquent lips of the gentleman who last addressed us. He has spoken of 'die wissenschaftliche Internationalität.' I heard those words with great pleasure. Whatever causes of discord may disturb international relations, it will be among the great features of the work of the Learned Societies that they will always entertain cordial relations with the learned men in all foreign countries. And, Mr. President and gentlemen, whatever may happen on the banks of the Nile, of this I am sure, that the cordial relations which have existed between my distinguished friend, Professor Ramsay, on the banks of the Thames and Monsieur Berthelot on the banks of the Seine, will remain the same

and tend to knit together that which ought never to be separated if the progress of civilisation is not to be interrupted. I give you the toast of 'The Learned Societies,' coupled with the names of Lord Lister and Professor Michael Foster."

Lord Lister: "Scientific men are not by any means always learned. Their devotion to their special studies often prevents such an occurrence. Nevertheless, I take it that in this toast the Learned Societies are understood to mean the scientific societies, and chiefly those of this metropolis. On this understanding, it seems to me very natural that the person who is asked to respond to this toast should be a representative of the Royal Society, because that Society is the mother of all the scientific societies in London; and while, if I may be allowed to say so, she is herself vigorous and active, she takes a deep maternal interest in the welfare of her offspring. Of her numerous progeny, none, I conceive, discharges her functions more healthily and efficiently than she who is this evening honouring some of her most illustrious and venerable sons. Among these it has been my joy to see my old teacher, the venerated and beloved Professor Williamson. The Royal Society, I believe, does good to her daughters, stimulating them to work, and encouraging fruitful intercourse among them: witness, for example, the discovery of argon by the co-operation of Lord Rayleigh and Professor Ramsay. Mr. President, I received from one of your Secretaries an intimation that brevity would be the most valuable quality in any remarks I might make this evening. I gladly act on that suggestion, and will only now tender to you and your Council, on behalf of the representatives of scientific societies, other than the Chemical Society, present here this evening, our warmest thanks for the privilege you have given us of taking part in this memorable celebration. I would also thank Lord Reay for the exceedingly kind terms in which he has proposed the toast, and this illustrious company for the cordial manner in which they have received it."

Professor Michael Foster: "I feel deeply grateful for the very kind words in which Lord Reay has referred to me and my possible future services, in which I trust he may not be disappointed, and for the kind way in which you have received the toast. I perceive the delicate compliment to my physiological acquirements in the inference that, although a President as yet unborn, I can speak. I did not know, in accepting office, that the sweets of office would come thus before their time. I trust that they will be taken off, so to speak, at the other end of the bill. But remembering that all premature utterances, whether vocal or other, are feeble, the more feeble, the more premature they are —and it seems to me that, as President of the British Association, I was conceived the other day—though I would have wished had not this premature deliverance been coupled with great lateness of the hour,

to have turned from an uncertain and dim future to a rich and full past, and to have said something of my experience of these six great men, all of whom I can call my friends, and one of whom—Williamson—taught me not only chemistry but science, I will content myself in saying this, that though I do not know what may be before me as President of the British Association—do not know what lions, true lions, false lions, there may be in my path,—I will do my best to make my tenure of office worthy, not only of the Association, but of Science. And may I also give utterance to this wish, in continuance of that international science of which my brother Ostwald spoke, that when the British Association meets at Dover, and the French Association meets at Boulogne, we shall feel that Fashoda is past over, and that we shall not be using the resources of science to make each other as small as we can, but that each will be using the strength of the other to advance the resources of a common knowledge."

"The Guests."

The Treasurer: "I have the honour to propose to you, Fellows of the Chemical Society, that you should drink to the health of your guests. We are favoured here to-night with the presence of a large and distinguished body of gentlemen; how large, and how distinguished, you yourselves may know by a mere glance at the list of their names which is already furnished to you. We are deeply grateful to these gentlemen for the way in which they have responded to the invitation of the Society to be present here to-night to do honour to the gentlemen who are our special guests. Large as the number is, we could well have wished that it was still larger; for our hospitality and our welcome have their physical limits only in the capacity of this room. We could well have wished, for example, that a greater number of our Foreign Fellows were here present. You have heard from the President many messages of congratulation and of goodwill from certain scientific organisations abroad, and from individual Fellows of our Society. But these messages by no means account for all the kind words, for all the utterances of friendship and felicitation, which have been made in reference to this occasion. I have recently passed through many Continental capitals, and have visited incidentally a number of academic centres, and I have had the pleasure of meeting a considerable proportion of those gentlemen whom we are proud to number amongst our Foreign members. Thus, I have met Franchimont at Leiden, Cleve at Upsala, Waage at Christiania, Pettersson and Arrhenius at Stockholm, Emil Fischer, Landolt, and van't Hoff at Berlin, Liebermann and Witt at Charlottenburg, Ladenburg at Breslau, our active collaborateur Brauner at Prague, our old friend Debus in Cassel, and last, but not least, the

doyen of the illustrious body, my venerated teacher Bunsen, at Heidelberg. And, gentlemen, I am charged by each and all to convey to you, should I have the opportunity, their heartfelt congratulations on this occasion, and their great regret that circumstances should have prevented them from being here to testify by their presence their appreciation of the great services which these gentlemen whom we especially delight to honour to-night, have rendered to Science, and to the Society of which we are so thankful to see them still members. I should like to say an additional word or two about Bunsen. His Excellency has learned to grow old gracefully. He bears the weight of his eighty-eight years admirably. His deafness, it is true, has somewhat increased, and he complained with a touch of pathos which, under the circumstances, has just a suspicion of the element of comedy, that 'he begins to find that his eyesight is not so good as it used to be.' It was for this reason that he asked to be excused from conveying in writing the message which he wished me verbally to transmit to you. I am asked to associate with this toast the name of Mr. Haldane and that of Dr. Böttinger. Mr. Haldane is known to all here for the admirable part he has taken in furthering a cause which many of us have very near at heart—that is, the advancement to its legitimate position of our Metropolitan University. Dr. Böttinger is known to many here as a leading member of a firm whose name is as a household word in the mouths of those who speak of the material and industrial triumphs of our science. Gentlemen, without further word, I give you the health of 'Our Guests,' and I associate with that toast the names of Mr. Haldane, Q.C., M.P., and Dr. Böttinger."

Mr. Haldane: "I confess I feel a little shy in uttering the few sentences which I have to address to you. Previous speakers have come before you with a wealth of distinctions and a profusion of academic tone which it is impossible for me to imitate. Lord Reay, who represents a different branch of the Legislature, has put me to shame, by telling me, that the House of Lords is 'sound on science.' Well, I am glad hear it, and I wish I could say as much for the House of Commons. I cannot speak to you as a man of science, nor as a representative of any department of abstract knowledge; I can only speak to you as a humble,—that most humble of all functionaries,—unofficial member of an Opposition, or what I fear some of you will consider, a battered and shattered fragment of a still more battered and shattered Party. I do not admit, needless to say, the impeachment. I do not regard myself in the least as an atom which has got outside its proper molecule. There is plenty of potential energy in my political combinations. When I was at the University of Göttingen, there was a song we used to sing, which ran "Die Philister sind uns gewogen meist." Even

members of the House of Commons acknowledge the deep debt they are under to-day to science, and perhaps most especially to chemical science. Gentlemen, there was a great victory won the other day in the Soudan. That victory was due to the forethought and skill of a very distinguished soldier: but also to another force. That victory, which pronounced once for all, and finally, the supremacy of mind and trained skill over the most powerful of savage combinations; that victory was won, not merely on the fields before Omdurman, but in the laboratory and the workshop. The smokeless powders, the modern rifling, the bullet of most recent construction, all these are your work. But the obligations which you have rendered us in the past are as nothing to the obligations to which some of us look forward to you in the future. We have spent money lavishly, without a word of complaint from the taxpayer, on the support of the Army and the Navy; but we have not yet spent the money which I believe we ought to spend, and shall be forced to spend, upon the defence of our industries. The country from which Professor Ostwald comes can teach us a lesson. In Germany, where 70 per cent. of the upkeep of the universities comes from the Government, they have taught us how to put mind into our work. There are men who would gladly convert the British public to it, but their work is yet to be done. We shall realise these things, when the House of Commons will vie with the House of Lords in giving predominance to the great task of diffusing scientific knowledge among our commercial men as among our soldiers. It is with that sentiment in my mind, with that feeling of obligation to these pioneers of the work of the members of this Society, that I gratefully thank you for the toast which has been proposed."

Dr. BÖTTINGER: "Allow me also to thank you most heartily and sincerely for the great honour you have conferred upon your guests by your kind invitation, and by putting them in a position to take part in this beautiful festival on the celebration of six Masters of English Science. Gentlemen, I may also thank you, most especially in my own name, for the great honour you have conferred upon me in mentioning my name specially among the toasts of the evening. I shall not forget this evening; it will always be in my mind a pleasant recollection of what Professor Ostwald said of you. In science we know no bounds and no boundaries internationally, for we are one great common nation. Your esteemed President, Professor Dewar, cordially remarked on the character of the messages you have received this evening from all parts of the scientific world. Allow me to add to these, and assure you that not only from the scientific world, but elsewhere these feelings are shared with the same heartiness with respect to the great work these gentlemen have done for the development of science and for the benefit of the human race. It is for me

a particular pleasure to see by the list of your numerous members and guests that you also acknowledge that science and industry and technique must go hand in hand; that we who reap the technical part must rely upon the men of science for new ideas and advancement of our work. But I believe and am convinced that the men of science in their connection with us also find new initiative for the furtherance of their ideas; they also find that in connection with the industrial and technical world they see what is further necessary for the development of their work. I am sure that the names of these six illustrious scientific men will be mark-stones in the world for the future, they will be stepping-stones for the new generations. Before I end, allow me to deviate from your English custom, and introduce a custom with us in Germany, a custom which is always followed with great enthusiasm, and to propose now the health of one whom particularly we have to thank for this beautiful evening: it is the health of a man who is a pioneer in science also, and has a great name. I need only remind you of liquefied air. I speak of Professor Dewar, and I ask you to join with me in a hearty three cheers for him. So take your glasses and join with me in our German fashion with Hoch! Hoch! Hoch!"

THE PRESIDENT: "My Lords and Gentlemen,—I must protest against the intrusion of an additional toast. We have had a most delightful evening; we have achieved our great aim; and I think that the present President is such a nonentity in comparison with the men we are here to honour, that the less said about him the better."

Letters, telegrams, and messages of congratulation were received from the following Foreign Members:—Professors Arrhenius, Stockholm; von Baeyer, Munich; Beilstein, St. Petersburg; Berthelot, Paris; Lecoq de Boisbaudran, Paris; Bunsen, Heidelburg; Cannizzaro, Rome; Cleve, Upsala; Curtius, Bonn; Erlenmeyer, Aschaffenburg; Fischer, Berlin; Fittig, Strassburg; Franchimont, Leiden; Friedel, Paris; Wolcott Gibbs, Cambridge, Massachusetts; Graebe, Geneva; van't Hoff, Berlin; Körner, Milan; Ladenburg, Breslau; Landolt, Berlin; Liebermann, Berlin; Lieben, Vienna; Markownikoff, Moscow; Mendeléeff, St. Petersburg; Menschutkin, St. Petersburg; Moissan, Paris; Nilson, Stockholm; Pettersson, Stockholm; Rammelsberg, Berlin; Raoult, Grenoble; Remsen, Baltimore; Schlœsing, Paris; Spring, Liège; Thomsen, Copenhagen; Troost, Paris; Waage, Christiania; van der Waals, Amsterdam; Wislicenus, Leipzig; Witt, Charlottenburg, and from a number of distinguished Fellows and friends of the Society.

A special vote of congratulation was passed by the Russian Chemical Society, and transmitted by Professor Mendeléeff.

"At a meeting of the Russian Chemical Society held this day, it was resolved, that the Society avail itself of the exceptional oppor-

tunity of being able to congratulate conjointly Sir Joseph Henry Gilbert, Sir Edward Frankland, Professor Odling, Sir F. A. Abel, Dr. A. W. Williamson, and Dr. J. H. Gladstone, whose distinguished services during half a century stand out as a model for all investigators in Chemical Science, and also express the wish to see the further results of their labours in the annals of Science for many years to come.

Hon. President, D. Mendeléeff.
Secretary, A. Gorboff.

St. Petersburg, $\frac{20 \text{ May}}{1 \text{ June}}$ 1898."

The following telegram was received from the German Chemical Society. "The sister Society sends both Jubilee congratulations and greetings to the Jubilee celebration of the Presidents of the Chemical Society, Gilbert, Frankland, Odling, Abel, Williamson, and Gladstone. The German Chemical Society, C. Liebermann, President."

November 17th, 1898. Professor Dewar, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. William Harcourt Branscombe, Verona, Eastbourne; Harry Estcourt Estcourt, Hayesleigh, Old Trafford, Manchester; George Cecil Fry, 1 Edinburgh Terrace, Newbury, Berks; John Golding, 1 Balmoral Road, Nottingham; Henry Winstone Harper, M.D., Austin, Texas, U.S.A.; James Hembrough, 159 Hotwell Road, Clifton, Bristol; Alfred Lucas, Maison Hussein Pasha, Cairo, Egypt; Samuel Montagu Martin, Westwood, Princetown Road, Bangor, co. Down; James Henry Pizey, 9 Lady Somerset Road, Highgate Road, N.W.; Robert Coleman Price, Blacksburg, Virginia, U.S.A.; Frederick Soddy, Merton College, Oxford; Louis Heathcote Walter, 83 Holland Park Avenue, W.; William Arthur Williams, 75 High Street, Wapping, E.

The following Candidates are recommended by the Council under Bye-law I (3):—Charles Robert Carroll, Hyderabad, Deccan, India; William Lash Miller, B.A., Ph.D., The University of Toronto; Frederick Louis Wilder, Villa Nova de Lima, Minas Geraes, Brazil.

The following papers were read.

133. "Determination of the constitution of fatty acids. Part I." By Arthur W. Crossley and Henry R. Le Sueur.

The paper gives a detailed account of experiments undertaken with the idea of devising a method for the determination of the constitu-

tion of fatty acids. An acid, $CH_2X \cdot CH_2 \cdot CO_2H$, is first converted into the ethylic salt of the monobromo-derivative, $CH_2X \cdot CHBr \cdot CO_2Et$, which is then treated with quinoline or diethylaniline, whereby the elements of hydrogen bromide are removed, and the ethylic salt of an unsaturated acid of the acrylic series, $CHX:CH \cdot CO_2Et$, is produced. The acid obtained by hydrolysing this salt is oxidised with potassium permanganate, giving rise to the corresponding dihydroxy-acid, $CHXOH \cdot CHOH \cdot CO_2H$, which is then oxidised with chromic acid, with the production of the acids $X \cdot CO_2H$ and $CO_2H \cdot CO_2H$. A fatty acid (or ketone) containing 2 carbon atoms less than the original acid has thus to be identified, and as the number of isomerides decreases greatly with loss of two carbon atoms, the possibility of identification is much enhanced.

The method has been carried out with valeric, isovaleric, and isobutylacetic acids with good results, the products identified being propionic acid, acetone, and isobutyric acid respectively.

The authors propose to continue the investigation with higher fatty acids, such as ethylisopropylacetic and stearic acids, and with a dibasic acid, such as pimelic (isopropylsuccinic) acid.

134. "The crystalline form of iodoform." By William Jackson Pope.

Considerable difficulty is experienced in obtaining iodoform in well developed crystals from solutions in the ordinary organic solvents, but it separates from acetone in magnificent six-sided tablets belonging to the hexagonal system. The crystals exhibit the forms $c\{111\}$, $r\{100, 22\bar{1}\}$, $p\{\bar{1}10\}$, and $m\{2\bar{1}\bar{1}\}$, and have the axial angle $\alpha = 93° 41'$; the double refraction is negative in sign and strong.

135. "The characterisation of racemic compounds." By Frederic Stanley Kipping and William Jackson Pope.

Having previously shown that crystallographic data afford a sure basis for the characterisation of racemic compounds, the authors now give the results of their examination of a method suggested and made use of by Ladenburg for this particular purpose.

Ladenburg stated (*Ber.*, 1894, 27, 3065) that if, on fractionally crystallising a mixture of an externally compensated substance with excess of one of the active constituents, the various fractions differ in specific rotation, the existence of a racemic compound is established; if, on the other hand, the various fractions have the same specific rotation, then the existence of a racemic compound is disproved.

The authors point out that the argument upon which Ladenburg's method is based is fallacious, and, further, on examining experimentally several cases of mixtures of an externally compensated substance with an excess of one of the optically active isomerides, they find that the method is valueless.

Mixtures of the non-racemic inactive sodium ammonium tartrate with the isomeric dextrotartrate, and of the racemic inactive sodium potassium tartrate with the corresponding dextrotartrate, were fractionally crystallised, and it was found that in each case the excess of dextrorotatory salt separated out first, most of the externally compensated substances remaining in the mother liquors.

136. "The occurrence of orthohydroxyacetophenone in Chione glabra." By Wyndham R. Dunstan and T. A. Henry.

The wood of *Chione glabra*, a large flowering tree indigenous to Grenada, has a strong aromatic, somewhat fœcal, odour. This is due to a volatile oil which the authors find is chiefly composed of *orthohydroxyacetophenone*, $C_6H_4Ac{\cdot}OH$. The oil also contains a minute amount of what appears to be the crystalline methyl ether of this substance, $C_6H_4Ac{\cdot}OMe$.

The properties of orthohydroxyacetophenone, prepared in the laboratory from orthonitrocinnamic acid as a starting point, agree precisely with those of the volatile oil of *Chione glabra*.

Discussion.

In reply to Dr. Harden, Professor Dunstan said that he thought the degradation of vegetable proteid a possible mode of origin of indole derivatives, though some botanists were of opinion that it was more probable that they resulted from simpler synthetic processes.

137. "Preparation of hyponitrite from nitrite through oxyamidosulphonate." By E. Divers and T. Haga.

The authors have already published, disconnectedly, the facts (1) that sodium nitrite can be very completely and easily changed into oximidosulphonate by dissolving it with the calculated quantity of sodium carbonate and passing sulphur dioxide into the solution; (2) that sodium oximidosulphonate can be hydrolysed very exactly into oxyamidosulphonate; and (3) that sodium oxyamidosulphonate can be largely decomposed into hyponitrite and sulphite by dissolving much potassium hydroxide in its concentrated solution. Details are now given by which, taking advantage of these facts, sodium nitrite

can be converted into 60 per cent. of its equivalent of silver hyponitrite. The essential points are to keep the temperature at 0° during the sulphonation of the nitrite; to allow the oximidosulphonate to hydrolyse, in the absence of sulphite, at or near the common temperature, during about 24 hours, so as to produce only oxyamidosulphonate and acid sulphate; to neutralise the solution by alkali carbonate, then dissolve in it sufficient potassium hydroxide to make the solution one of about equal weights of the hydroxide and water (having taken care from the first to use as little water as possible), and allow the whole to stand during 30 hours; to fractionally precipitate the hyponitrite by silver sulphate (or nitrate) from the greatly diluted alkaline solution, leaving the sulphite and the alkali in solution; to separate the silver hyponitrite from the metallic silver, &c., which accompanies it, by dissolving it in very cold dilute sulphuric acid, then filtering, and finally neutralising the sulphuric acid by sodium carbonate with the greatest expedition. Some oxyamidosulphonate always escapes decomposition by the potassium hydroxide; of that decomposed, about 80 per cent. becomes hyponitrite, and the rest nitrous oxide and alkali, besides, of course, sodium sulphite in either case.

138. "Absorption of nitric oxide in gas analysis." By E. Divers.

A concentrated alkaline solution of sodium or potassium sulphite absorbs nitric oxide completely and quickly, forming with it alkali (hypo)nitrososulphate, and can be used in gas analysis with satisfactory results.

139. "Interaction of nitric oxide with silver nitrate." By E. Divers.

Silver nitrate decomposes freely in a current of nitric oxide at much lower temperatures than when heated in air or carbon dioxide. The products, apart from oxygen, are the same, namely, nitric peroxide, silver, and silver nitrite, except that the silver nitrite is, for a time, an abundant product in presence of nitric oxide, whereas in its absence, when the temperature of decomposition is much higher, only a little of the nitrite is ever found, because it passes probably into nitric peroxide and silver nearly as fast as it is produced.

Either nitric oxide acts directly upon the silver nitrate, or, what is more probable, the imperceptible decomposition of silver nitrate alone, at temperatures of 220—250°, into oxygen and nitrite becomes rapid and marked in presence of nitric oxide, in consequence of the latter taking up oxygen as fast as it is formed by the decomposing nitrate.

Nitric oxide has no effect on heated sodium, potassium, barium, and lead nitrates.

140. "Preparation of pure alkali nitrites." By E. Divers.

Alkali nitrites are easily obtained pure and in concentrated solution by passing nitrous gases containing slight excess of nitric oxide into concentrated solutions of pure potassium or sodium hydroxide or carbonate, out of contact with air. With ordinary care, no nitrate is formed; it is a current mistake to suppose that it is.

Both nitrites are slightly yellow, and their concentrated solutions markedly yellow. The sodium salt melts at 213°; at 15°, 6 parts of water dissolve 5 parts of it. Its crystals are often very large, but very thin, flattened prisms, moderately deliquescent. Sodium nitrite can be readily purified by recrystallisation; potassium nitrite cannot. Potassium nitrite occurs only in minute, short prisms, and is soluble in one-third of its weight of water. It is exceedingly deliquescent, but its crystals are actually anhydrous, although Lang and Hampe independently found them to contain $\frac{1}{2}H_2O$.

Discussion.

Mr. Groves remarked that sodium nitrite is manufactured on a large scale for use in the colour industry, and is sent into the market nearly pure, containing some 98 per cent. of the salt, but as far as his experience went neither the salt nor the solution is yellow.

He had found that when arsenious anhydride is heated at 70° with nitric acid of sp. gr. 1·3, nearly pure nitrous anhydride, mixed only with a little nitric oxide, is evolved, and that a dilute solution of nitrous acid could readily be prepared by passing this vapour into water at 0° containing some crushed ice.

141. "The reduction of an alkali nitrite by an alkali metal." By E. Divers.

Nitrous oxide, nitrogen, hydroxylamine, ammonia, sodium hyponitrite, and sodium hydroxide are invariably products of the reduction of sodium nitrite by sodium amalgam, but the process can be modified so that each of them in turn shall be formed in any desired quantity between a very small amount and a certain maximum. The principal points needing attention are the degree of concentration of the solution and the temperature at which the reduction takes place.

The quantity of hyponitrite will be equivalent to more than one-sixth of the nitrite when the solution is concentrated and is not

allowed to grow too hot; by large dilution, alone or aided by heat, it can be made indefinitely small. That of hydroxylamine may be made to be anything between one-eleventh and one three-hundredth of the equivalent of the nitrite, sufficient dilution and cooling being the conditions for a high yield of hydroxylamine. Ammonia being merely reduced hydroxylamine, its yield depends on that of hydroxylamine and reduction of this by the further action of the amalgam. The temperature at which the reduction is allowed to proceed determines how much of the gaseous products shall be nitrous oxide and how much nitrogen, high temperature causing the production of nitrogen. The two gases together are always nearly equivalent to a little more than four-fifths of the nitrite.

Sodium amalgam is entirely without action upon sodium hyponitrite. It has always very little action, if any, upon nitrous oxide at the common temperature. Sodium hyponitrite in concentrated sodium hydroxide solution is very stable and may be heated at 100° without effervescing. During the reduction of the nitrite, the gases produced may be seen to come exclusively from the surface of the solution touching the amalgam. As already indicated, the production of nitrous oxide and of nitrogen is at the expense one of the other, not at that of the hyponitrite or hydroxylamine. Similarly, the hyponitrite and hydroxylamine increase each at the expense of the other. Yet it does not seem that the nitrogen is produced by reduction of the nitrous oxide, and certainly the hydroxylamine is not a reduction product of the hyponitrite. It also does not seem that the nitrous oxide comes from the decomposition of the sodium hyponitrite to any important extent.

Sodium nitrite, reduced by sodium amalgam, passes, it would seem, first into the unknown transition products, NaNO and NaON, to the extent of four-fifths into the former and one-fifth into the latter. From the latter, or sodioximide radicle, the hyponitrite will be formed by condensation when the alkali solution is concentrated, and the hydroxylamine by reduction when the alkaline solution is dilute. From the former, or sodium nitroside radicle, the nitrous oxide will be produced by condensation and hydrolysis at low temperatures, or the nitrogen by reduction, condensation, and hydrolysis, at high temperatures.

The reduction of potassium nitrite by potassium amalgam proceeds closely on the same lines as that of sodium nitrite by sodium amalgam.

142. "Hyponitrites; their preparation by sodium or potassium, and properties." By E. Divers.

Sodium nitrite reduced in concentrated solution by sodium amalgam, yields a third of its weight of silver hyponitrite, and nearly the

equivalent amount of several other hyponitrites, without the need of this salt as an intermediary. In this respect, the process has an advantage over the oxyamidosulphonate method. The hydroxylamine, which always accompanies the sodium hyponitrite, is easily got rid of by the continued action of the sodium amalgam, which is without action on the hyponitrite itself. The resulting ammonia is removed by exposure of the solution over sulphuric acid for a night under reduced pressure. Mercuric oxide, employed by all other chemists to remove hydroxylamine, has the fault of regenerating nitrite. The concentrated solution of sodium hyponitrite and hydroxide, thus obtained, is remarkably stable. In the preparation from it of other salts than the sodium salt itself and the silver salt, the sodium hydroxide has first to be neutralised, after diluting the solution with ice and water, mercurous nitrate being employed as an indicator with portions of the solution.

Sodium hyponitrite is prepared from the most concentrated alkaline solution, obtained as above, by precipitation with absolute alcohol, or (Jackson) by evaporation in a vacuum and washing the salt with alcohol. It forms minute, crystalline granules, $(NaON)_2+5H_2O$, which effloresce and evolve nitrous oxide in the air, but in a vacuum desiccator are converted into an anhydrous non-coherent powder, stable in dry air. The anhydrous salt bears a somewhat high temperature in dry air without decomposition, then fuses and effervesces, forming sodium oxide, sodium nitrite, and nitrogen. According to Prof. Ikeda, sodium hyponitrite gives numbers for its molecular magnitude approximating to those required for $(NaON)_2$ by Lowenherz's cryoscopic method.

Silver hyponitrite is prepared by adding a highly dilute solution of silver sulphate or nitrate to the alkaline solution already described. It decomposes exceedingly slowly in the moist state, forming products similar to those obtained on heating. It is also decomposed by bright light, becoming brown, but is not blackened, by the light alone. When heated, it is decomposed without explosion, its yellow colour changing directly to that of metallic silver, without intermediate darkening; the products are silver, silver nitrate, nitrogen, nitric oxide, and nitric peroxide. A study of the change renders it most probable that the nitric oxide and silver nitrate are not primary products, but arise from interaction between the nitric peroxide and undecomposed hyponitrite. Sodium chloride solution digested with excess of silver hyponitrite has only 25/43 of its chlorine displaced by the hyponitrite ion. Paal's supposed silver nitrito-hyponitrite, $Ag_2N_2O_3$, appears not to exist.

The preparation and properties of mercuric, mercurous, cupric, lead, barium, strontium, calcium, and potassium hyponitrites are described. Cuprous hyponitrite could not be obtained, nor were Rây's basic mer-

curic compounds met with. Maquenne's hypo-isonitroso-acetates were examined, and the formula $OAc{\cdot}Ca{\cdot}O{\cdot}N_2{\cdot}OAc,Ca(OAc)_2,5H_2O$ is suggested for the calcium salt.

Hyponitrous acid, in solution, is more acid to litmus paper than carbonic acid, but its effect disappears as the paper dries. It decomposes slowly into nitrous oxide and water (and nothing else except a trace of nitrous acid having another origin). When pure, it has no action on iodine-water or with the starch-iodide test. It decomposes silver carbonate, sulphate, nitrate, and chloride, when present in excess but not the iodide. It is easily oxidised, but is unaffected by reducing agents. Apparently it has not yet been obtained free from every trace of nitrous acid; when carefully prepared, it will remain, however, for more than an hour without producing a blue colour with the starch-iodide test. Hyponitrous acid can be estimated gravimetrically as the silver salt, and volumetrically by potassium permanganate. Thum's permanganate process, in which the hyponitrous acid becomes ultimately nitric acid, is an excellent one; the failure of Hantzsch and Sauer and of Kirschner in its use is due to the modifications they made in it.

Discussion.

Professor Dunstan remarked that Dr. Divers in the present series of papers had cleared up a number of doubtful points. In connection with the formation of hyponitrite by the reduction of nitrite in aqueous solution, Dr. Divers had confirmed the observations made in 1887 by Mr. Dymond and himself, as to the simultaneous production of hydroxylamine and its non-formation by the further reduction of hyponitrite. He still adhered to the view that they put forward that these results were best explained by the assumption that the nitrite was first hydrogenated, forming a compound of the formula $NaN(OH)_2$, which on the one hand loses water, forming hyponitrite, and on the other is hydrolysed, forming sodium hydroxide and dihydroxylamine, $NH(OH)_2$, which by further reduction furnishes hydroxylamine.

Mr. G. N. Huntly pointed out that the hypothesis of the formation of dihydroxylamine, as a first reduction product, suggested by Professor Dunstan had the advantage of being equally applicable to the two other methods of preparing hyponitrites, viz., from sodium hydroxylaminesulphonate (Divers), and benzenesulphohydroxamic acid (Piloty), by the action of concentrated potash. The three reactions on this hypothesis would be represented as follows:—(1) $NH(OH)(SO_3Na) + KOH = KNaSO_3 + NH(OH)_2$; (2) $NH(OH)(SO_2{\cdot}C_6H_5) + KOH = C_6H_5{\cdot}SO_2K + NH(OH)_2$; (3) $HO{\cdot}NO + 2H = NH(OH)_2$.

In alkaline solution, the dihydroxylamine would condense thus, $OH{\cdot}NH{\cdot}OH + H(OH)N{\cdot}OH = OH{\cdot}N{:}N{\cdot}OH + H_2O$, and there being

no tendency to condensation in acid solution, further reduction should give hydroxylamine, a conclusion in accordance with the facts observed by Professor Divers.

143. "Paranitro-orthanisidine." By Raphael Meldola, F.R.S.

As paranitro-orthanisidine (m. p. 139°—140°), which was described in a paper published in conjunction with Messrs. Woolcott and Wray (Trans., 1896, 69, 1330), has recently been made the subject of a patent by the "Fabriques de Produits Chimiques de Thann et de Mulhouse" (Germ. Pat., 98637 of 1897), the author records some further observations which have been made with the substance, as it is proposed to continue its investigation.

The acetyl derivative, purified by repeated crystallisation from water so as to get rid of the isomeric metanitro-derivative simultaneously formed, melts at 153—154°, the melting point 143—146° given in the former paper being that of the mixed isomerides. The acetyl-derivative of *p*-nitro-*o*-anisidine can be reduced by dissolving in hot water and agitating with iron dust and a little acetic acid. The *p*-amido-*o*-acetanisidide thus formed is somewhat unstable, and has not yet been isolated. It is readily diazotisable, and the NH_2-group has by this means been replaced by iodine with the formation of *p-iodo-o-acetanisidide*, [NHAc : OMe : I = 1 : 2 : 4]. This compound crystallises in beautiful, silvery scales melting at 175—176°.

0·1778 gave 7·4 c.c. moist nitrogen at 19° and 764 mm. N = 4·80.
0·202 „ 0·1618 AgI. I = 43·28.

The formula requires N = 4·81 per cent.; I = 43·64 per cent.

Mr. Frederick Henry Streatfeild was assisting in this investigation, but having left to accept an appointment elsewhere, the work was temporarily interrupted.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates will be balloted for on Thursday, December 1, 1898.

Bell, Hugh Poynter,

30, Egerton Crescent, S.W.

Student. B.A. Cambridge, 1894. Studied Chemistry at Kiel and Bonn, 1895—1898.

Henry E. Armstrong.	Sidney Williamson.
Edwin C. Jee.	Gerald T. Moody.
William A. Davis.	William J. Pope.

Berry, Reginald Arthur,

The University Chemical Laboratory, Cambridge.

Private Assistant to Professor Liveing since May, 1895. Associate of the Institute of Chemistry (new regulations). Cambridge University Diploma in Agriculture.

G. D. Liveing.	H. J. H. Fenton.
W. J. Sell.	Thomas H. Easterfield.

T. B. Wood.

Birkett, Walter,

23, Cheviot St., Lincoln.

Head Master of Lincoln Higher Grade School. Lecturer in Chemistry at Lincoln Christ's Hospital Buildings (four years). Lecturer in Agricultural Chemistry as applied to Agriculture at Lincoln Training College (four years). Student of Chemistry (two years) under E. C. Gill, B.A., B.Sc. (Lond.). Desirous of Fellowship for purpose of keeping abreast of recent discoveries in Chemical Science through the medium of the Society's publications.

John Hope Belcher.	*Hy. Fairrie.*
F. Percy Watson.	*Francis Henry Tate.*
Hudson Donaldson.	*Chas. Bradshaw.*

W. H. Stables.

Boardman, Thomas Henry,

4, St. George's Terrace, Wilton, Taunton.

Science Master at Huish School, Taunton. Teaching experience of one year. Second Class Natural Science Honours Degree at Cambridge (Peterhouse), taking Chemistry as one of my subjects.

W. J. Sell. — William French.
H. J. H. Fenton. — James Dewar.
W. T. N. Spivey. — Charles T. Heycock.

Bogert, Marston Taylor, A.B., Ph.B.,

259, Broadway, Flushing, New York, U.S.A.

Instructor in Organic Chemistry at Columbia University, New York City. Investigations on Sulfocyamides, Imides, Nitrils, &c. "Carbon Compounds used in Medicine." Lectures and papers showing relation between physiological action and chemical constitution, &c., &c.

H. T. Vulté. — Jas. S. C. Wells.
C. F. Chandler. — Elwyn Waller.
Arthur H. Elliott.

Brooke, Arthur,

17, Cavendish Square, Hull.

Science Master, B.A. (Natural Science Tripos), Cantab., late of St. John's College, Cambridge. First M.B. examination. For five years Science Master, Hull Grammar School. Lecturer in Electricity and Physiology at the Young People's Christian and Literary Institute, Hull.

W. J. Sell. — S. Ruhemann.
H. J. H. Fenton. — W. T. N. Spivey.
C. T. Heycock.

Brünnich, Johannes Christian,

Agricultural College, Gatton, Queensland.

Chemist to the Department of Agriculture, Queensland. Student for three years of the Chemical Faculty of the Polytechnic School in Zürich, 1879—1881. For several years Analyst in Bohemian Sugar Factories. For ten years Chemist and Mill Manager of the Colonial Sugar Refining Company's Sugar Mill at Homebush.

A. Alexander Ramsay. — Thos. Steel.
T. W. Walton. — Jas. Morison.
F. B. Guthrie.

de Castro, John Paul,

Ford House, Redruth, Cornwall.

Principal of and Lecturer in Inorganic Chemistry, Metallurgy, and Mineralogy, at the Redruth School of Mines. 1890—1892, Student

in Laboratory and School of Chemistry, Margate, G. R. Tweedie, F.C.S., Principal. 1892—1895, Student in the Cambridge University Chemical Laboratory. Passed Parts I. and II. of Special Examination in Chemistry for B.A. degree. 1895—1897, worked in the Metallurgical Laboratories of the Royal School of Mines, S.K., and obtained Certificate for passing in final examination in Metallurgy and Assaying.

W. C. Roberts-Austen. H. J. H. Fenton.
W. J. Sell. G. D. Liveing.
S. Ruhemann. Henry C. Jenkins.

F. H. Neville.

Chapman, David Leonard,

Hulme Hall, Plymouth Grove, Manchester.

Demonstrator, Owens College. B.A., Oxford (Final Honours School in Chemistry and Physics) Demonstrator at the Owens College, Manchester, in Chemistry.

H. B. Dixon. G. H. Bailey.
W. H. Perkin. E. J. Russell.

D. S. Jerdan.

Crouch, William Samuel,

Colombo, Ceylon.

Pharmaceutical Chemist and member of the Pharmaceutical Society of Great Britain. Formerly Student in the Pharmaceutical Society's School of Chemistry. Now Laboratory Manager to the Colombo Apothecaries Company.

Charles Ekin. Edward F. Harrison.
M. Carteighe. *Walter Hills.*
W. Watson Will. *E. J. Millard.*
Robert Haselwood Jones. *J. C. Stead.*

Ernest Goulding.

Cunnington, Alfred Valentine,

Christ's College, Cambridge.

Scholar of Christ's College. Natural Sciences Tripos, Part I., June, 1897. Natural Sciences Tripos, Part II., June, 1898. Carrying out Research work to Dr. S. Ruhemann.

S. Ruhemann. R. S. Morrell.
W. A. Shenstone. A. Hutchinson.
M. M. Pattison Muir. *R. H. Adie.*

Davidson, William Brown,

29, Bedford Street, Liverpool.

M.A., B.Sc., Ph.D., Private Research Assistant to Professor J. Campbell Brown. Contributions to Chemical Science:—(1) "Inter-

action of 1 : 2-Diketones with Primary Amines of the General Formula $R'{\cdot}CH_2{\cdot}NH_2$." By F. R. Japp, F.R.S., and W. B. Davidson, M.A., B.Sc., *Trans. Chem. Soc.*, 1894, pp. 32—47. (2) "Condensation of Benzile with Ethylic Malonate." By F. R. Japp and W. B. Davidson. *Trans. Chem. Soc.*, 1895, pp. 132—139. (3) "Ueber Diazophenole." By A. Hantzsch und W. B. Davidson. *Ber.*, **29**, 1522—1536. (4) "Physikochemische Untersuchungen über Diazoniumsalze, Diazoniumhydrat und normale Diazotate." By W. B. Davidson und A. Hantzsch, *Ber.*, **31**, 1612—1648. (5) "Inaugural Dissertation zur Erlangung der Doctorwürde." Würzburg, February, 1898, pp. 155. Was engaged for a year (1893–94) as Private Research Assistant to Professor Japp, Aberdeen.

J. Campbell Brown.	W. Collingwood Williams.
Charles A. Kohn.	F. R. Japp.
John Harger.	T. S. Murray.

Dickson, Samuel,

The Kraal, Elm Road, New Malden.

Analytical Chemist. I have acted as chief assistant Chemist to Messrs. Stanger and Blount, of Broadway, Westminster, for the last 11 years, and in their laboratory have carried out many technical investigations and analyses of structural materials, waters, soils, clays and metalliferous minerals for the Crown Agents for the Colonies and other Government Departments.

W. Harry Stanger.	W. J. Atkinson Butterfield.
Bertram Blount.	Leonard M. Nash.
H. Wilson Hake.	A. Dupré.

Drake, Francis Alfred,

Rivington and Blackrod Grammar School, Horwich, Lancs.

Teacher of Chemistry. Have taken the degree of Bachelor of Science, London (1895); have been a Teacher of Chemistry for 5 years, and am much interested in the advancement of Chemical Science and Teaching.

Chas. Mills.	Richard Berncastle.
Gerald T. Moody.	*A. Lapworth.*
William J. Pope.	*Arthur Marshall.*

Ferguson, James Edward,

26, Connaught Road, Stroud Green, London, N.

Analytical Chemist and Assayer. Student in Chemistry during four sessions, under Prof. Isaac S. Scarf, F.I.C., F.C.S., at the City of London College, White Street, E.C. Hold the following Certificates from H.M. Dept. of Science and Art, viz., 1st class Theoretical In-

organic Chemistry, advanced stage; 1st class Practical Inorganic Chemistry, advanced stage; 1st class Theoretical Metallurgy, advanced stage; and 2nd class Practical Metallurgy, advanced stage. Also two Certificates granted by the Council of the City of London College, viz., 2nd class Theoretical Inorganic Chemistry, and 1st class Practical Inorganic Chemistry. Over 6 years' experience in Analytical Chemistry, as assistant to Mr. Edwd. Riley, F.I.C., F.C.S., of 2, City Road, London, E.C., and 2 years Chief Chemist to the company working the Royal Iron Ore Mines in the Island of Elba, Italy. Presently Analytical Chemist and Assayer to a firm of mineral merchants in London.

Edwd. Riley.	Harold W. Harrie.
William H. Martin.	F. W. Daw.
Isaac S. Scarf.	*E. J. Jackman.*

Gardner, Edward,

27, Thurlow Road, Hampstead, N.W.

Technical Chemist. I have studied Inorganic and Organic Chemistry for 3 years at the City and Guilds Technical College, Finsbury, and have been engaged for 3 years as Chemist to Messrs. Johnson, Matthey & Co.

George Matthey.	Francis H. Carr.
R. Meldola.	M. O. Forster.

R. C. T. Evans.

Goldsmith, John Naish,

Rock House, Tunbridge Wells.

Chemist to the British Xylonite Co., Manningtree, Essex. Bachelor of Science in Chemistry (Victoria), 1894. Ph.D. Heidelberg, 1898. Dissertation "Über Me·I·Ph-3-Cyclohexenon-5," &c.

H. B. Dixon.	G. H. Bailey.
D. S. Jerdan.	W. A. Bone.
W. H. Perkin.	J. F. Thorpe.

W. T. Lawrence.

Hadley, E. B.,

The Green, Calne, Wilts.

Science Master and Superintendent of Agricultural Experiments to the Wilts County Council. Head Master Calne Technical School. I have lectured on Chemistry for the last 15 years, and conducted classes in Practical Chemistry for the last 12 years. I am in charge of the Agricultural Experimental Stations at Quemerford, Lickhell, and the Sands under the Wilts C.C.

Chapman Jones.	W. Palmer Wynne.
G. S. Newth.	Fredk. Wm. Brown.

A. E. Tutton.

Hartridge, Alfred,

14, Broad Street, Oxford.

B.A. Exeter College, Oxford. 1st Class in Final School of Natural Science (Chem.), 1897. Engaged in teaching and research.

John Conroy.	John Watts.
W. W. Fisher.	J. E. Marsh.
D. H. Nagel.	V. H. Veley.

Haworth, John,

4, Horsdon Terrace, Tiverton, Devon.

Public Analyst and Teacher of Chemistry. Public Analyst to the Borough of Tiverton, and for 9 years Demonstrator of Chemistry in the laboratory of Blundell's School, Tiverton.

Morris W. Travers.	A. H. Mitchell.
Frank Scudder.	*William G. White.*

H. E. Roscoe.

Hendry, Alexander Garden,

14, Avenell Road, London, W.

Laboratory Manager to Messrs. Lorimer & Co., Manufacturing Chemists, London. Pharmaceutical Chemist, 1st class Advanced Organic Chemistry, 1st class Advanced Inorganic, Heriot Watt College, Edinburgh.

Frederick R. Holloman.	F. Stanley Kipping.
William Duncan.	W. H. Perkin, jun.
Alex. Gunn.	John Fleet.

Peter MacEwan.

Holroyd, George William Fraser,

10, Kensington Garden Terrace, London.

Student of Chemistry. Fell Exhibitioner of Christ Church, Oxford. First class in Chemistry in the School of Natural Science. Has worked for 2 years in Munich under Professor v. Baeyer.

A. Vernon Harcourt.	Frank Clowes.
John Conroy.	D. H. Nagel.

P. Elford.

Howe, Walter,

45, Spring Gardens, Bradford.

Brewer and Chemist. Have attended Courses of Lectures on both Theoretical and Practical Chemistry. Am member of Yorkshire Institute of Brewing, and was on committee from commencement until I resigned last year. Being interested in practice and science of

brewing, am desirous of keeping in touch with the latest developments of the chemistry of the subject.

Alex. K. Miller.	*Chas. William Sutton.*
Arthur W. Rogers.	*Alfred Gordon Salamon.*
J. A. Fawcett.	*A. Hadley.*

Basil P. Wigan.

Hill-Jones, Thomas,
Eagle Wharf Road, London.

Manufacturing Chemist. Succeeded grandfather and father in business of Chemical Manufacturers. Studied Chemistry at Birkbeck Institute, London, and worked in laboratory at the works. Had charge of all departments of manufacture until succeeded father as head of the business.

Frederic H. Bowman.	T. A. Reid.
F. E. Bowman.	Francis Henry Tate.

E. Douzard.

Jordan-Smith, Benjamin,
42, King's Road, Reading.

Science Master in Longton Endowed School, and Instructor in Chemistry to the Longton Corporation's Technical Classes. Associate of the Royal College of Science in Chemistry.

T. E. Thorpe.	Walter Palmer.
W. Palmer Wynne.	*Thomas Turner.*
A. E. Tutton.	

Kay, Reginald Arundale,
7, The Causeway, Cambridge.

Agriculturist. Member of the Royal Agricultural College, by Examination. Student at above in Analytical Chemistry.

Edward Kinch.	*John A. Voelcker.*
Cecil Cooke Duncan.	*T. A. Dickson.*
John Stewart Remington.	*James Muir.*

Mascarenhas, John Charles,
35, Harold Road, Upton Park.

Analytical Chemist, &c. Student of Theoretical and Practical Chemistry for 7 years at City of London College. Holder of 2 Advanced Certificates in Chemistry, and still prosecuting the study of Organic Chemistry. Student of Physics. Engaged in the analysis of minerals, &c. Have a good knowledge of Pharmaceutical Chemistry and Materia Medica.

Isaac S. Scarf.	E. J. Jackman.
Horace V. Buttfield.	Charles A. West.

Vivian B. Lewes.

Nightscales, Thomas Arthur,
Tynemouth Street, Hull.

Assistant Laboratory Manager and Analyst for Messrs. Allison, Johnson and Foster, Limited, Hull. Pupil, G. Carr-Robinson, Esq., F.C.S., F.I.C., &c., Hull. Assistant 12 months of Mr. Luxton, Chemist, Hull Municipal Technical Schools. At present engaged in Analytical and Technical work in connection with Pharmacy.

Thomas Tyrer.	Fred. E. Johnson.
Harry Thompson.	G. Carr-Robinson.
H. Irving Foster.	*Edward G. Gravill.*

Pollard, William,
Hitchin, Herts.

Temp. Assistant Geologist, Geological Survey. "Acidmetrische Bestimmung d. Molybdansaüre" (Sentert and Pollard, *Z. Anorg. Ch.*, 8, 296). "Atomgewicht d. Molybdäns" (Sentert and Pollard, *Z. Anorg. Ch.*, 8, 439). "Note on Lead Tetracetate" (Hutchinson and Pollard, *Trans. Chem. Soc.*, 1893, 63, 1136). "Lead Tetracetate and the Plumbic Salts" (Hutchinson and Pollard, *Trans. Chem. Soc.*, 1896, 69, 212).

M. M. Pattison Muir.	W. T. N. Spivey.
S. Ruhemann.	T. B. Wood.
A. Hutchinson.	R. S. Morrell.

Ray, John Armstedt, jun., B.A.,
15, Nassau Street, Dublin.

Analytical and Pharmaceutical Chemist. Has been a Student in the Dublin University Laboratory for two years, and is engaged in Pharmaceutical practice.

J. Emerson Reynolds.	Emil A. Werner.
G. Percy Bailey.	*Chas. R. C. Tichborne.*

Harry Carter Draper.

Rich, Edmund Milton,
7, Therapia Road, Honor Oak, S.E.

Science Master. A. C. G. I. Science Master Colfe Grammar School.

Henry E. Armstrong.	William Jackson Pope.
Edwin C. Jee.	William A. Davis.
Thomas Martin Lowry.	Gerald T. Moody.

W. Palmer Wynne.

Rigg, Gilbert,
Tudor Villa, Bryn Road, Swansea.

Chemist and Managing Director. Nine years as student, assistant, and manager in the laboratory of Dr. C. A. Burghardt, Analytical

Chemist, of Manchester. Student of Chemistry and Prizeman in Mineralogy at Owens College, Manchester. Co-patentee with Dr. Burghardt in a process for treating refractory ores of zinc and other metals, and Managing Director of the Manchester Zinc and Copper Co., Ltd. formed to work the same.

Edw. Schunck. David Watson.
George J. Allen. Walter Ratcliffe.

J. Carter Bell.

Rofe, Henry John,

8, Powis Square, Bayswater, W.

Civil Engineer. B.A. Balliol College, Oxford, with Honours in Chemistry. Interested in the application of Chemistry to Engineering.

A. Vernon Harcourt. John Conroy.
D. H. Nagel. C. J. Baker.

William E. Moss.

Sand, Henry J. S.,

2, Cantlowes Rd., Camden Sq., N.W. (or Tieckstrasse 12, Dresden).

At present engaged in research work at the Chemical Laboratory of University College, London. Studied Chemistry from 1892 to 1894 at the Royal Saxon Polytechnic of Dresden, and afterwards at the Federal Swiss Polytechnic of Zürich till 1896. After that engaged in a research on nitroso-bodies, at Zürich, till the end of 1897, the results of which appeared in my Inaugural thesis. Holder of the Diploma of the Zürich Polytechnic, and of the degree of Doctor of Philosophy of the University of Zürich.

William Ramsay. Frank Collingridge.
J. Wallace Walker. A. M. Kellas.

Edward C. Cyril Baly.

Seligman, Richard,

15, Queen's Gate Gardens, London, S.W.

Recently engaged in research at the Central Technical College, and shortly proceeding to work under Professor Curtius, Associate of the City and Guilds of London Institute, after having spent three years in the Chemistry Department of the Central Technical College under Professor Armstrong.

Henry E. Armstrong. Rudolph Messel.
William A. Davis. Gerald T. Moody.
Edwin C. Jee. Sidney Williamson.

Senior, George, B.A. (London),

"Arwendon," Abergele, North Wales.

Certificated Teacher. Science Master of Abergele County School.

Have taught Chemistry in Higher Grade Schools at Rochdale and Nottingham, and also at Aberayron County School, for over 12 years.

Thos. W. Berry. W. B. Hards.
Wm. A. Knight. *Gerald G. Quinn.*
Duncan T. Richards. *Herbert Entwistle.*

Smiles, Samuel, jun., B.Sc.,
Fairoak, Beckenham, Kent.

Chemist. Research Student in University College Chemical Laboratory.

William Ramsay. G. Nevill Huntly.
Morris W. Travers. A. M. Kellas.
Edward C. Cyril Baly. Frank Collingridge.

Steuart, Basil,
Broxburn, near Edinburgh.

Chemist. Studied Chemistry under D. R. Steuart, F.I.C., Broxburn, and Prof. Gibson, Heriot Watt College, Edin. Have worked all day in chemical laboratory for last 4 years. Now Assistant Chemist, Broxburn Oil Works.

J. Gibson. D. R. Steuart.
John E. Mackenzie. William S. Anderson.
Robert Irvine.

Walton, Ambrose,
"Gledholt," Lower Broughton Road, Broughton.

Chemical Manufacturer. Now proprietor of the firm of Walton, Jackson and Co., "Globe Chemical Works," late "Aqueduct Works," Marple. I have been, for the 3 years ending 1897, manager of A. Walton and Co.'s Chemical Works of Longwood, Milnsbridge, and Manchester. For 2 years Secretary to John McCall and Co., Ltd., Chemical Manufacturers, Manchester. I have studied the theory of Chemistry as applied to my branch of the industry, and am still prosecuting researches in various directions.

Harry Grimshaw. Hy. Ellison, jun.
C. Sordes Ellis. *George H. Hurst.*
H. F. A. Wigley.

Woods, Charles William Tuthill,
St. Kilda, Tudor Road, Upper Norwood, London.

Science Master, Grammar School, Ashby-de-la-Zouch. (Mr. Woods was Senior Scholar of his year in Natural Science at Sidney Sussex College, Cambridge, but was prevented by illness from taking a degree.—F. H. N.)

F. H. Neville. G. German.
C. T. Heycock. *S. Ruhemann.*
M. M. Pattison Muir.

Young, John Henry, B.Sc.,

115, Birmingham Road, Oldbury, Near Birmingham.

Assistant Chemist at Aluminium Co., Ltd., Oldbury, and Teacher of Chemistry at Wednesbury Technical School, 1893–6. Chemical Honours Student at Owens College, Manchester, June, 1896. Obtained degree of B.Sc. in Honours School of Chemistry, September, 1896, and at present Assistant Chemist in Aluminium Co., Ltd., Oldbury, August, 1897, and at present Teacher of Chemistry Wednesbury Technical School.

H. B. Dixon. A. William Gilbody.
W. H. Perkin, jun. T. E. Thorpe.
A. Harden.

The following Certificates were authorised by the Council under Bye-law I (3).

Carroll, Charles Robert,

Hyderabad, Deccan, India.

Surgeon and Chemical Analyst to the Government of His Highness the Nizam of Hyderabad. Lecturer on Chemistry in the Hyderabad Medical School. Licentiate in Medicine and Surgery of the University of Madras.

Wyndham R. Dunstan.

Miller, William Lash, B.A., Ph.D.,

Chemical Laboratory, The University of Toronto.

Demonstrator of Chemistry, the University of Toronto, Toronto, Canada. Publications: Dissertation 1890. *Zeit. phys. Chem.*, 1892; *Journal of Phys. Chem.*, 1897. Demonstrator in the University of Toronto since 1891.

William H. Pike. W. Hodgson Ellis.
Frank T. Shutt.

Wilder, Frederick Louis,

Villa Nova de Lima, Minas Geraes, Brazil.

Analytical Chemist. Six years assistant in Chemical Laboratory, Charterhouse School, Godalming, Surrey, Rev. S. D. Titmas, Master. Chemist to D. C. Griffiths, Esq., Assayer to Bank of England. Chief Chemist to St. John del Rey Mining Co., Brazil. Associate of Institute of Mining and Metallurgy, London. Member Society of Chemical Industry, London.

T. H. Lee.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in December. Applications for grants, accompanied by full particulars, should be received by the Secretaries not later than December 5th. Forms of application can be obtained from the Assistant-Secretary, Chemical Society, Burlington House, W.

NOTICE TO AUTHORS.

As the *Proceedings* go to press on the Monday after each ordinary Meeting of the Society, the announcement of papers for the next Meeting cannot be made in this publication unless the papers are in the hands of the Secretaries by noon on that day.

At the next meeting, on December 1st, there will be a Ballot for the Election of Fellows, and the following paper will be communicated.

"The oxidation of polyhydric alcohols in presence of iron." By H. J. H. Fenton, M.A., and H. Jackson, B.A., B.Sc.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 8/12/1898

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 200. Session 1898–9.

December 1st, 1898. Professor Dewar, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. Samuel William Allworthy, The Manor House, Antrim Road, Belfast; John Frank Blackstraw, Holly Bank, Marton, Chelford, Cheshire; Henry Cort Harold Carpenter, 109 Banbury Road, Oxford; Frank Cope, 30 Leeds Road, Dewsbury; Thomas James Cozens, The Grammar School, Middleton-in-Teesdale, Co. Durham; Samuel Godfrey Hall, 19 Aberdeen Park, Highbury, N.; Thomas Anderson Henry, 37 Chelsea Gardens, S.W.; Thomas Luxton, 4 Cavendish Square, Margaret Street, Hull; James Roberts, jun., 43 Great Western Road, Glasgow; Frederick William Skirrow, Graystongill, Bentham, Lancaster; Charles Emerique Szarasy, 19 Weymouth Street, Portland Place, W.; Thomas Wilson Wormell, 184 Burrage Road, Plumstead, S.E.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected.

Hugh Poynter Bell, B.A.; Reginald Arthur Berry; Walter Birkett; Thomas Henry Boardman, B.A.; Marston Taylor Bogert, A.B., Ph.B.; Arthur Brooke, B.A.; Johannes Christian Brünnich; John Paul de Castro; Charles Robert Carroll; David Leonard Chapman, B.A.; William Samuel Crouch; Alfred V. Cunnington, B.A.; W. Brown Davidson, M.A., Ph.D.; Samuel Dickson; Francis Alfred Drake, B.Sc.; James Edward Ferguson; Edward Gardner; John Naish Goldsmith, B.Sc., Ph.D.; E. B. Hadley; Alfred Hartridge, B.A.; John Haworth; Alexander Garden Hendry; George W. F. Holroyd, B.A.; Walter Howe; Thomas Hill-Jones; Benjamin Jordan-Smith; Reginald Arundale Kay; John Charles Mascarenhas; William Lash Miller, B.A., Ph.D.; Thomas Arthur Nightscales; William Pollard, B.A., Ph.D.; John Armstedt Ray, jun., B.A.; Edmund Milton Rich;

Gilbert Rigg; Henry John Rofe, B.A.; Henry J. S. Sand, Ph.D.; Richard Seligman; George Senior, B.A.; Samuel Smiles, jun., B.Sc.; Basil Steuart; Ambrose Walton; Frederick Louis Wilder; Charles William Tuthill Woods; John Henry Young, B.Sc.

The following papers were read:—

144. "The oxidation of polyhydric alcohols in presence of iron." By Henry J. Horstman Fenton, M.A., and Henry Jackson, B.A., B.Sc.

In continuation of the study of the influence of ferrous iron on the oxidation of various hydroxy-compounds, the authors are engaged in investigating the behaviour of various alcohols, and the present communication gives an account of the results which, so far, have been obtained.

The monhydric alcohols (methylic, ethylic, propylic, isopropylic, and amylic), under the conditions employed, give entirely negative results either in presence or absence of iron. But in the case of all the polyhydric alcohols examined (ethylene glycol, glycerol, erythritol, mannitol, dulcitol, and sorbitol) it is found that the presence of ferrous iron exerts a remarkable influence on oxidation by means of hydrogen dioxide. In the absence of iron, practically no change is produced, but, in its presence, very considerable rise of temperature occurs in all cases, and the alcohol is vigorously oxidised.

Ethylene glycol yields glycollic aldehyde, but apparently no glyoxal. With glycerol, the product appears to be glyceraldehyde with little or no dihydroxyacetone. From erythritol, a product yielding erythrosazone is obtained, and mannitol gives mannose. The yields, generally, are remarkably good as compared with those obtained by oxidation with nitric acid, &c., and in this way it is easy to obtain mannose directly from mannitol without first preparing the hydrazone. The authors are attempting to isolate tetrose in a similar way.

As in the case of tartaric acid, it is found that certain of these polyhydric alcohols may be similarly oxidised by atmospheric oxygen in presence of ferrous iron and of sunlight.

145. "The occurrence of hyoscyamine in the Hyoscyamus muticus of India." By Wyndham R. Dunstan and Harold Brown.

The authors find that the stem and leaves of the Indian *Hyoscyamus muticus* contain about 0·1 per cent. of hyoscyamine, and that the alkaloid can be extracted in a pure state from this plant more readily than from ordinary henbane. The plant is fairly abundant in the Punjab and Beluchistan, and is likely to prove of value both as a drug, and as a source of hyoscyamine.

Discussion.

Professor Dunstan, in reply to Mr. Groves, Mr. David Howard, and Mr. Page, said it was possible that age and climate might have some influence in changing the hyoscyamine and forming other mydriatic alkaloids. There was every reason to believe that the physiological action of the drug was principally due to the alkaloid it contains, and not to any other constituent.

Dr. W. H. Perkin, F.R.S., then took the Chair, and the following paper was read:—

146. "The comparative colour of the vapour of iodine in gases at atmospheric pressure and in a vacuum." By James Dewar, LL.D., F.R.S.

Recently, having had occasion to compare iodine with other substances as a means of obtaining vacua in the construction of vessels used for the storage and manipulation of liquid air in low temperature research, some facts about the behaviour of the vapour of iodine have been observed which deserve to be recorded. Pure iodine in the solid state is usually stated to be perfectly opaque to light, but this is not the character of iodine distilled and condensed on a surface of glass at temperatures between $-180°$ and $-190°$ in vacuum test tubes or bulbs by the use of liquid air. Under such conditions, it is easy to get transparent films of iodine of varying grades of thickness showing brilliantly the colours of thin plates by reflection, and to keep them permanently as long as the low temperature is maintained. The first addition of liquid air to the vacuum bulb or test tube containing excess of solid iodine causes instant precipitation of an opaque film, but this can be avoided by cooling the iodine, which has been caused to sublime to the lower part of the outer test tube or bulb, by a preliminary treatment with a little solid carbon dioxide.

In this condition, when the inner surface of the vacuum vessel is cooled with liquid air, the iodine can only deposit from an atmosphere of great tenuity, and when a given thickness of deposit is reached, any increase can be stopped by removing the vessel from the liquid carbon dioxide and placing it in liquid air. In the same way, films of other substances can be deposited which may be useful in the examination of many physical problems. Stas says that pure iodine gives no visible vapour at the ordinary temperature, but this is contrary to the author's experience. Samples of iodine, obtained from cuprous iodide, from iodoform, and from solution of iodine in potassium iodide, and in sufficient quantity to ensure saturation, gave, in half-litre flasks, a visible colour to the atmosphere at the

ordinary temperature. When, however, a similar flask containing the same iodine was exhausted of air, the colour of the atmosphere was markedly less, and this distinction remained even when the flasks were heated side by side in a water bath. If the iodine vapour diffused into an atmosphere of carbon dioxide, hydrogen, or oxygen, in similar flasks, instead of into air, the colour remained the same; but in all cases it was much more marked than in one from which the gaseous atmosphere, other than iodine, had been in great part removed by the air pump. No change in the mode of filling the air and vacuum flasks made the difference in colour disappear, although a dozen flasks have been filled from time to time. No change in the character of the results was effected by subliming the iodine from anhydrous baryta and keeping it in flasks for months with excess of the latter, nor was any apparent difference produced when the flasks containing the baryta were repeatedly heated at the boiling point of water. This seems to prove that neither water vapour nor hydrogen iodide has anything to do with the cause of the difference in colour of the iodine vapour in the air and vacuous flasks. It is not necessary to use flasks, as two lengths of glass tubing, an inch or less in diameter and a foot or more in length, when heated side by side in a steam or water bath, show the difference of colour.

To obtain an approximate value of the tension of the saturated vapour of iodine at about the ordinary temperature, a Rankine formula of two terms was calculated, taking the known pressure at 58·1° as 4·9 mm. and that at 113·8° as 87 mm. These gave:—(1) $\log P = 9{\cdot}3635 - \frac{2872}{T}$ mm. If, however, the tension at 85° and 114·1° are selected for calculation, (2) $\log P = 10{\cdot}0392\ \frac{3137}{T}$ mm., where T is the absolute temperature. From formula (1) the tensions in mm. of mercury at 0° and 11° are respectively 0·07 and 0·18. The weight of iodine in a litre would thus become about 1 and 1·94 milligrams at 0° and 11° respectively. In order to check this calculation, the quantity of iodine required to saturate a litre of dry air at 0° and 11° was determined by passing a slow current of air over a column of the substance and subsequently absorbing the iodine from the saturated air by passing it through a caustic potash solution. The alkaline solution, after acidifying, was titrated with sodium thiosulphate. The results of the experiments were as follows:—

	Milligrams per litre.	Pressure in mm. of mercury.
0°	0·24	0·017
11°	1·25	0·087
30°	4·70	0·358

In each case, the calculated tension is less than that deduced from the first vapour pressure equation. The values approach those given by Arctowski (*Zeit. Anorg. Chem.*, 1896, 12, 427) as a deduction from his experiments on the volatilisation of iodine. From this, it would follow that the second equation for the tension is the better. In the liquid state, the tensions are well represented by (3) $\log P = 7{\cdot}924 \frac{2316}{T}$ mm. From formula (2), the molecular latent heat of solid iodine is 14430 units, and for the liquid condition from (3) the value is 10653. The experimental value of the latent heat of liquid iodine given by Favre is 6000 units. From this, it would follow that the latent heat of volatilisation requires to be redetermined. It is interesting to observe that the number of heat units required to dissociate the molecule of iodine is 28500, or roughly, twice the calculated latent heat of the solid.

The various experiments recorded lead to the conclusion that the phenomenon is a real one, although some factor that has been neglected may explain it; at any rate, it is difficult to avoid getting the result. Assuming it to be true, its explanation then remains to be considered. It is well known that the vapour pressure in a vacuum is often greater than in air at atmospheric pressure. On the other hand, Professor J. J. Thomson, in his work entitled *Application of Dynamics to Physics and Chemistry*, p. 169, discusses this very question. He shows that the effect of the pressure of an inert gas must be to raise the vapour pressure of a substance diffusing into it above that produced by the diffusion of the same substance into a vacuous space. Taking the equation which he there developed as being applicable to iodine, the difference between the two conditions of pressure should amount to $\frac{1}{440}$ of the whole. Now the question arises whether this amount is sufficient to explain the difference of colour or whether it is necessary to bring in other factors which may operate, such as solution of solids in gases under pressure, dissociation, or want of equilibrium. Further experiments will be required before a definite answer can be given.

Hannay and Hogarth first showed that alcohol vapour above its critical point, and therefore at a pressure above 60 atmospheres, can dissolve solids like potassium bromide or iodide, and Cailletet, a little later, found that liquid carbon dioxide was dissolved by air under high compression. Dr. Villard has recently made a series of experiments on the same subject, in which he proves that bromine and iodine dissolve in air or oxygen under high compression. He says: "L'iode se dissout egalèment en quantité sensible dans l'oxygène, mais le phénomène n'est bien visible qu'a partir de 100 atmosphères et dans des tubes de 5 millimetres de diametre au moins."

The experiment exhibited would appear to show that the pressure of one atmosphere is sufficient to produce a sensible difference of colour in the case of iodine vapour diffused in air and in a vacuum. For the present, it may be regarded as a lecture illustration of the rapidity of volatilising iodine in an air space as contrasted with a vacuous one.

Discussion.

Dr. Thorpe thought that the phenomenon which the President had brought to the notice of the meeting was highly interesting and suggestive. It seemed to him, after watching the experiment shown to them during its whole course, that the character of the colour of the resulting vapours was so markedly different as to lead to the inference that something more than a mere dilution of colour due to an actual difference in the amount of vapour present had occurred. He could not help comparing the phenomenon with the well-known difference in colour of various solutions of iodine in alcohol, carbon disulphide, chloroform, &c., and thinking that molecular dissociation was taking place. Perhaps in this connection it might be worth while to make a comparative spectroscopic study of the vapours in the two conditions.

Professor F. D. Brown said that he, too, had remarked the much browner colour of the iodine vapour in the vacuous tube. Remembering the fact that iodine in brown solutions is in a different molecular condition from that in violet solutions, it seemed probable that the vapours in the two tubes were also in different molecular conditions.

With regard to the suggestion that the iodine was in some way dissolved in the gas, he stated that one of his students in New Zealand had ascertained that equal volumes of different gases at the same temperature and pressure took up exactly equal quantities of iodine, whereas it was probable that if iodine dissolved in a gas as a solid dissolves in a liquid differences in solubility would have been found.

Mr. Elworthy, in reference to the solubility of solids in gases at temperatures above their critical points, and under pressure, said that when in Bombay he gave instructions for some vulcanised rubber to be placed in a vessel with carbon dioxide at about 5 or 6 atmospheres pressure; instead of this, about 5 pounds of the gas were introduced into a vessel usually employed to contain 15 pounds of liquefied carbon dioxide. At temperatures below the critical point a certain amount of liquefied gas would have been present, but as the temperature was between 87° and 90° F., the gas was in the condition of a vapour under pressure. On opening the vessel and allowing the gas to escape, it was found that practically all the sulphur had been dissolved out of the

rubber, the surface of which was covered with a thin crust of sulphur crystals.

Mr. L. M. Jones asked whether any attempt had been made to determine the actual concentration of the iodine in the two cases; and also whether the apparent solubility of a solid in gas at high pressure might not be actually due to the increase of vapour pressure predicted by Professor J. J. Thomson.

Dr. Travers pointed out that the critical phenomena observed when the air confined over liquid carbon dioxide was compressed at constant temperature could not be produced by conditions similar to those which were present in the case of the iodine and air. When air was compressed in contact with any liquid, it dissolved and produced a mixture of constantly decreasing critical temperature. Consequently, supposing that sufficient air were present, it should in any case be possible by exerting sufficient pressure to produce a mixture whose critical temperature was the temperature of the experiment. The phenomenon could have nothing to do with the solution of the solid or liquid in the gas.

Dr. Forster inquired whether iodine had been imprisoned in atmospheres other than a mixture of nitrogen and oxygen. If, as was suggested, the phenomenon in question is a case of solution, differences in appearance similar to that subsisting between solutions of iodine in alcohol and in carbon disulphide, might be expected in tubes containing iodine enclosed with various inert gases.

The President, in reply, said that the spectroscope had not been used in his experiments, and bearing in mind the character of the absorption spectrum of iodine, he anticipated it would be difficult to obtain any information as to the character of the phenomenon by its employment. The possibility of dissociation had not escaped attention, having been mentioned in the paper. All that he could say was that at present he could not specifically state that the difference in the behaviour of iodine under the two conditions was due to one or other of the possible causes to which he had referred. Iodine enclosed in tubes containing gases such as carbon dioxide, nitrogen, hydrogen, and oxygen gave appearances indistinguishable from those observed in similar tubes containing air.

NOTICE TO AUTHORS.

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At the next meeting, on Thursday, December 15th, the following papers will be communicated:—

"The interaction of ethylic sodiomalonate and mesityl oxide." By Arthur W. Crossley, Ph.D.

"Derivatives of camphoric acid, Part III." By F. Stanley Kipping, D.Sc., F.R.S.

"Synthesis of $\alpha\beta\beta$-trimethylglutaric acid." By W. H. Perkin, jun., and J. F. Thorpe.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 22/12/1898

PROCEEDINGS
OF THE
CHEMICAL SOCIETY.

EDITED BY THE SECRETARIES.

No. 201. Session 1898–9.

December 15th, 1898. Professor Dewar, F.R.S., President, in the Chair.

Mr. H. P. Bell was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. Stuart Blofeld, 4, Camden Gardens, West Kensington Park, W.; Bertram H. Bowles, 53, Dunsmure Road, Stamford Hill, N.; Thomas John Cheater, 6, Boutflower Road, Wandsworth Common, S.W.; George Ward Hedley, 2, St. Luke's Villas, Cheltenham; Harold Octavius Knight, Westfield Villa, Barton-on-Humber; Dudley Northall-Laurie, 56A, Pall Mall, S.W.; James McCracken, 580, Govan Road, Govan, N.B.; John O'Sullivan, 742, Nicola Street, Vancouver City, B.C.; Arthur Lee White, 29, Huron Road, Upper Tooting, S.W.

The following papers were read:—

147. "The interaction of ethylic sodiomalonate and mesityl oxide." By Arthur W. Crossley.

Attempts to prepare dihydrocamphoric acid synthetically have so far proved unsuccessful (*Trans.*, 1898, **73**, 23). Isobutylene dibromide does not condense with ethylic sodiomethylmalonate, nor mesityl oxide with ethylic sodiomalonate, in the expected manner. The thick, oily product obtained in the latter case cannot be distilled in a vacuum without partial decomposition; when hydrolysed with alcoholic potash, it yields a dibasic *acid*, $C_{16}H_{24}O_4$, which crystallises from acetone in colourless, transparent, lustrous prisms belonging to the monosymmetric system, and melts at 148—148·5°, the upper part of the capillary tube becoming covered with a red film. The *ethylic* salt separates from light petroleum in thick, transparent, lustrous prisms, which usually are twinned and apparently belong to the monosymmetric system. It melts at 59·5—60°, boils at 252° in air without

decomposition, and, on hydrolysis, yields the original acid. The *silver* salt crystallises from water in feathery needles.

Sodium amalgam is without action on the acid. Bromine readily converts it into a *dibromo*-derivative, $C_{16}H_{24}O_4Br_2$ or $C_{16}H_{22}O_4Br_2$, which crystallises from dilute alcohol in colourless, glistening leaflets containing $2H_2O$, and melts with slight decomposition at 171°. On treatment with hydrogen bromide, a *dihydrobromide*, $C_{16}H_{26}O_4Br_2$, is obtained, which crystallises in transparent prisms, melts at 169° with decomposition, and is reconverted into the acid, $C_{16}H_{24}O_4$, by interaction with alcoholic potash.

The acid is readily oxidised by alkaline potassium permanganate in the cold, and when the product is treated with chromic acid, an acid melting at 89° is obtained. It is hoped that a study of its oxidation products will give some clue to the constitution of the substance.

148. "The interaction of ethylic malonate and acetylene tetrabromide in presence of sodium ethoxide." By Arthur W. Crossley.

This investigation was undertaken in the hope that ethylic disodiomalonate and acetylene tetrabromide would interact according to the equation, $C_2H_2Br_4 + 2Na_2C(CO_2Et)_2 = (CO_2Et)_2C{:}CH{\cdot}CH{:}C(CO_2Et)_2 + 4NaBr$, as the product, on hydrolysis and subsequent heating, should yield muconic acid, $CO_2H{\cdot}CH{:}CH{\cdot}CH{:}CH{\cdot}CO_2H$, from which tetrabromadipic acid could be prepared for the purpose of investigating its behaviour with weak alkalis.

The reaction does not take place as expected, and is of a complicated nature, the two main products being tribromethylene, $CHBr{:}CBr_2$, and tetrethylic acetylenetetracarboxylate; during its progress acetylene is given off, and tarry products are also formed from which no definite chemical compound could be isolated.

The acetylene tetrabromide used was prepared from acetylene generated from calcium carbide by the action of water, and purified by Willgerodt's method (*Ber.*, 1895, **28**, 2108). It boiled at 151° under 54 mm. pressure, and was a clear, colourless, highly refractive liquid.

0·1548 gave 0·3353 AgBr. Br = 92·18.

$C_2H_2Br_4$ requires Br = 92·48 per cent.

Acetylene tetrabromide (1 mol.) was added to a mixture of sodium (2 mols.) dissolved in absolute alcohol and ethylic malonate (2 mols.), and after the violent reaction had somewhat moderated, the whole was heated on a water bath for 1½ hours. Water was added to the resulting dark, reddish-green, feebly-acid product, and the whole extracted with ether. On washing the ethereal extract with water,

the greater portion of the red colouring matter (from which the tarry products alluded to were obtained) was removed, and also a small quantity of a green solid containing sodium and organic matter. When boiled with acids, this green substance partially dissolved, forming a red solution, which was again turned green by addition of an alkali; but the amount was too small for investigation. On distilling the residue from the dried ethereal extract, fractions were obtained boiling at 65—80° and at 225—230° under 47 mm. pressure; and not more than 0·5 c.c. passed over between these limits.

The fraction boiling at 65—80° under 47 mm. pressure contained tribromethylene, $CHBr{:}CBr_2$. This clear, colourless, heavy liquid, amounting to 63 per cent. of the total ethereal extract, was repeatedly fractionated at the ordinary pressure, and nearly the whole passed over between 164—166°; the residue, when heated above this temperature, gave off bromine and hydrogen bromide, and consisted probably of some unchanged acetylene tetrabromide. On analysis the fraction boiling at 164—166° gave the following numbers.

0·3410 gave 0·7251 AgBr. Br = 90·47.

$CHBr{:}CBr_2$ requires Br = 90·56 per cent.

The substance was further characterised by converting it into pentabromethane by the direct addition of bromine. The resulting solid crystallised from alcohol in long, white, glistening needles melting at 55—55·5°.

0·2656 gave 0·5887 AgBr. Br = 94·31.

$CHBr_2{\cdot}CBr_3$ requires Br = 94·11 per cent.

The fraction boiling at 225—230° under 47 mm. pressure contained tetrethylic acetylenetetracarboxylate. This fraction solidified almost completely. It was spread on a porous plate, and then purified by recrystallisation from light petroleum boiling at 60—80°, from which it separated in long, white, silken needles melting at 75—76°.

0·1518 gave 0·2936 CO_2 and 0·0940 H_2O. C = 52·76; H = 6·87.

$(CO_2Et)_2CH{\cdot}CH(CO_2Et)_2$ requires C = 52·83, H = 6·91 per cent.

Although the conditions under which the reaction was carried out were varied to some extent, the same results were always obtained.

149. "Derivatives of camphoric acid. Part III." By F. Stanley Kipping, D.Sc., F.R.S.

This paper contains an account of the preparation, properties, and transformations of a number of compounds which have been obtained from π-bromocamphoric acid, and is a continuation of previous work (*Trans.*, 1896, **69**, 913; Kipping and Pope, *Trans.*, 1897, **71**, 963).

πw-Dibromocamphoric acid, πw-dibromocamphoric anhydride and π-bromocamphanic acid have been already briefly described (*Proc.*, 1895, **11**, 211).

$w\pi$-Chlorobromocamphoric anhydride, $C_8H_{12}ClBr<\begin{matrix}CO\\CO\end{matrix}>O$, is obtained by treating π-bromocamphoric acid with phosphorus pentachloride, and then passing chlorine into the product heated at 100°. It crystallises in large, orthorhombic prisms melting at 214—215°, and resembles the corresponding dibromo-compound in ordinary properties.

$w\pi$-Chlorobromocamphoric acid, $C_8H_{12}ClBr(CO_2H)_2$, can be prepared by heating its anhydride with concentrated nitric acid; it is a colourless, crystalline compound melting at about 197°, and is very like the dibromo-acid in all respects.

When $w\pi$-chlorobromocamphoric anhydride is boiled with dilute acetic acid, it is converted into a π-bromocamphanic acid, identical with the compound melting at 176—177°, obtained by the decomposition of πw-dibromocamphoric anhydride.

Methylic π-bromocamphanate, $CO_2Me\cdot C_8H_{12}Br<\begin{matrix}CO\\O\end{matrix}$, is easily obtained from the corresponding acid by the ordinary methods; it crystallises in orthorhombic prisms, melts at 87—88°, and dissolves freely in most of the ordinary organic solvents.

π-Bromocamphanamide, $NH_2\cdot CO\cdot C_8H_{12}Br<\begin{matrix}CO\\O\end{matrix}$, is produced when πw-dibromocamphoric anhydride is left in contact with aqueous ammonia, and can also be prepared from methylic π-bromocamphanate in a similar manner; it crystallises in transparent needles melting at 161—162°.

The action of alkalis on πw-dibromocamphoric anhydride results in the formation of hydroxy-*cis*-π-camphanic acid (*Trans.*, 1896, **69**, 913), but when the anhydride is heated with an aqueous solution of silver nitrate, it is partly converted into the γ-lactone of hydroxycamphotricarboxylic acid (*loc. cit.*); the last-named compound is also formed when π-bromocamphanic acid is boiled with an aqueous solution of silver nitrate.

150. "Synthesis of $\alpha\beta\beta$-trimethylglutaric acid." By W. H. Perkin, jun., and J. F. Thorpe.

This acid, which is especially interesting on account of the fact that Balbiano (*Ber.*, 1895, **28**, 2161) obtained it by simple reactions from camphoric acid, may be prepared synthetically in the following way.

Ethylic cyanacetate is digested in alcoholic solution with sodium ethylate and ethylic dimethylacrylate, and the product,

which contains the sodium compound of *ethylic α-cyano-ββ-dimethylglutarate*, $CO_2Et(CN)CNa\cdot CMe_2\cdot CH_2\cdot CO_2Et$, is treated with methylic iodide. The resulting *ethylic α-cyano-αββ-trimethylglutarate*, $CO_2Et(CN)CMe\cdot CMe_2\cdot CH_2\cdot CO_2Et$, a colourless oil boiling at 181° under 25 mm. pressure, yields on hydrolysis *αββ-trimethylglutarimide*, $CMe_2<\begin{matrix}CH_2—CO\\CHMe\cdot CO\end{matrix}>NH$, which crystallises in long needles and melts at 126°.

αββ-Trimethylglutaric acid, $CO_2H\cdot CHMe\cdot CMe_2\cdot CH_2\cdot CO_2H$, is obtained from this imide by heating with hydrochloric acid at 200°; it melts at 88°, gives an *anhydride* melting at 82°, and an *anilic acid* melting at 150°, and is, in all its properties, identical with the acid obtained from camphoric acid by Balbiano.

151. "Hydrolysis of methylic and ethylic γ-cyanoacetoacetates and their derivatives. Part I." By W. Trevor Lawrence.

A preliminary account is given of the results obtained in an investigation which had for its primary object the preparation of unsymmetrically disubstituted ethylic acetonedicarboxylates, but has led to the discovery of a new series of acids.

Methylic γ-cyanodimethylacetoacetate, $CN\cdot CH_2\cdot CO\cdot CMe_2\cdot CO_2Me$, is the chief product of the interaction of methylic γ-bromodimethylacetoacetate with potassium cyanide in ethereal solution. It boils at 126—128° under 18 mm. pressure. On treatment in ethylic alcohol solution with dry hydrogen chloride, it yields an oil, $CO_2Et\cdot CHCl\cdot CO\cdot CMe_2\cdot CO_2Et$, which boils at 146—150° under 40 mm. pressure, and when hydrolysed with concentrated hydrochloric acid is converted into *αα*-dimethyl-*β*-hydroxyglutaconic acid. Sodium amalgam does not reduce the nitrile under the varied conditions employed, but converts it into dimethylmalonic acid.

Methylic γ-cyanodimethylacetoacetate is hydrolysed rapidly by concentrated hydrochloric acid, and converted quantitatively into a substance which is regarded provisionally as *αα-dimethyl-β-hydroxyglutaconic acid*, $CO_2H\cdot CH{:}C(OH)\cdot CMe_2\cdot CO_2H$, although several of its reactions are difficult to explain if the formula adopted is correct. Thus, the compound remains unchanged on boiling with sulphuric and with nitric acids, is not affected by potassium permanganate at 60°, and gives no coloration with ferric chloride. The acid crystallises from water in prisms, melts at 214°, and distils at 245°. The *hydrogen silver* salt, $C_7H_9O_5Ag$, and the corresponding *copper* and *zinc* salts have been obtained. The *aniline* salt melts at 122°. The *dimethylic* salt, $CO_2Me\cdot CH{:}C(OH)\cdot CMe_2\cdot CO_2Me$, crystallises in needles, melts at 104°, and boils at 285°. The *acetyl* derivative melts

at 136°, and the *benzoyl* derivative at 208°. When the acid is treated with phosphorus pentabromide and the product poured into methylic alcohol, the methylic salt of a bromo-derivative is obtained which, on hydrolysis with hydrobromic acid, yields *aa*-dimethylglutaconic acid.

aa-Dimethylglutaconic acid, $CO_2H \cdot CH{:}CH \cdot CMe_2 \cdot CO_2H$, is also obtained by the reduction of dimethylhydroxyglutaconic acid with hydriodic acid at 130° in sealed tubes. It crystallises from water in prisms, melts at 148°, and is not reduced by sodium amalgam in the cold.

The following compounds have also been prepared:—*Ethylic γ-bromomethylethylacetoacetate*, $CH_2Br \cdot CO \cdot CMeEt \cdot CO_2Et$, boiling at 164° under 75 mm. pressure; *ethylic γ-cyanomethylethylacetoacetate*, $CN \cdot CH_2 \cdot CO \cdot CMeEt \cdot CO_2Et$, boiling at 158° under 35 mm.; *aa-methylethyl-β-hydroxyglutaconic acid*, $CO_2H \cdot CH{:}C(OH) \cdot CMeEt \cdot CO_2H$, melting at 164°; *ethylic γ-bromodiethylacetoacetate*, $CH_2Br \cdot CO \cdot CEt_2 \cdot CO_2Et$, boiling at 180° under 100 mm. pressure; *ethylic γ-cyanodiethylacetoacetate*, $CN \cdot CH_2 \cdot CO \cdot CEt_2 \cdot CO_2Et$, boiling at 158° under 75 mm. pressure; *aa-diethyl-β-hydroxyglutaconic acid*, $CO_2H \cdot CH{:}C(OH) \cdot CEt_2 \cdot CO_2H$, melting at 159°.

Different results are obtained by the hydrolysis of these nitriles by means of sulphuric acid and of methyl alcoholic potash; moreover, the products of the reduction of the hydroxyglutaconic acids with hydriodic acid differ with the conditions; the author is engaged in investigating these reactions, as well as the behaviour of the γ-nitriles of ethylic acetoacetate and its derivatives generally.

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Fresenius, H. Geschichte des chemischen Laboratoriums zu Wiesbaden während der zweiten 25 Jahre seines Bestehens. 4to. Pp. xx + 128, with a frontispiece and 2 plans, l.p. Wiesbaden 1898. From the Author.

van't Hoff, J. H. Leçons de Chimie Physique. Première Partie. La Dynamique Chimique. Traduit par M. Corvisy. 8vo. Pp. 263. Paris 1898. From the Publishers.

Mitchell, A. H. Quantitative Practical Chemistry. Part I., Elementary Stage. Pp. 70. Part II., Advanced Stage Quantitative (Volumetric) and Qualitative Analysis. Pp. 76. Reading. 1898. From the Author.

Williams, C. W. The Combustion of Coal and the Prevention of Smoke Chemically and Practically Considered. Part the First. Pp.

xii + 158 + xxvi. 8vo. London and Liverpool. Second edition, 1841. (With a volume of plates.) From Prof. Meldola.

Williams, C. W. Plates illustrative of the Combustion of the Gaseous Portion of Coal, and of the Modes by which it may be effected in Furnaces. Lithographed in colours by George Smith and Co. 14 plates (7 folding). Liverpool 1841. From Prof. Meldola.

II. *By Purchase.*

Boltzmann, Ludwig. Vorlesungen über Gastheorie. I. Theil. 8vo. Pp. viii + 204. Leipzig 1896. (In progress.)

Classen, A. Handbuch der analytischen Chemie. I. Theil Qualitative Analyse. Fünfte, vermehrte und verbesserte, Auflage. 8vo. Pp. xii + 242. Stuttgart 1896. (In progress.)

Maercker, M. Handbuch der Spiritusfabrikation. Siebente, vollständig neubearbeitete Auflage. Mit 216 in den Text gedruckten Abbildungen. Pp. xxiv + 783. Berlin 1898.

Meyer, Victor, und Jacobson, Paul. Lehrbuch der organischen Chemie. Zweiter Band. Erste Abteilung. Pp. i + 320. Leipzig 1895. Zweiter Abt. 8vo. Pp. 321—576. Leipzig 1896. (In progress.)

Neumann, Bernhard. Theorie und Praxis der analytischen Elektrolyse der Metalle. 8vo. Pp. viii + 224. Halle a.-S. 1897.

Neumeister, R. Lehrbuch der physiologischen Chemie mit Berücksichtigung der pathologischen Verhältnisse. Zweite Auflage. Pp. xviii + 927. Mit 1 lithographischen Tafel. Jena 1897.

Schäfer, E. A. Text-book of Physiology. Vol. I. Pp. xviii + 1036. London 1898.

Tschirch, A., und Oesterle, O. Anatomischer Atlas der Pharmakognosie und Nahrungsmittelkunde. Erste Abteilung. Tafel 1—40. 4to. Pp. iv + 174. Leipzig 1896. (In progress.)

Pamphlets.

Baker, R. T., and Smith, H. G. On the Essential Oil and the presence of a Solid Camphor or Stearoptene in the "Sydney Peppermint," *Eucalyptus piperita*, Sm. (Read before the Royal Society of N.S. Wales, August 4, 1897.)

—— On the "Stringybark" Trees of N.S. Wales, especially in regard to their Essential Oils. Part I. (Read before the Royal Society of N.S. Wales, July, 1898.)

Borns, H. Die Elektrochemie im Jahre 1897. (Reprinted from *Chemischen Industrie*). Pp. 75. Berlin 1898. From the Author.

Fairley, Thomas. On the Water Supplies of Yorkshire. (Reprinted from the *Journal of the Fed. Inst. of Brewing*, 1898.)

Fischer, F. Chemische Technologie an den Universitäten und technischen Hochschulen Deutschlands. 8vo. Pp. 54. Braunschweig 1898.

Fresenius, H. Zur Erinnerung an R. Fresenius. 8vo. Pp. xviii. With a Portrait. Wiesbaden 1897.

Fresenius, Th. W. Ueber die Entwickelung der analytischen Chemie in den letzten 50 Jahren. 8vo. Pp. 16. Wiesbaden 1898.

Hintz, Ernst. Ueber Gasglühlicht. 8vo. Pp. 45. Wiesbaden 1898.

Mathews, J. A. The Action of Nitriles upon Aromatic Acids. Easton 1898.

Spring, W. Sur la cause de l'absence de coloration de certaines eaux limpides naturelles. Bruxelles 1898.

NOTICE TO AUTHORS.

As the *Proceedings* go to press on the Monday after each ordinary Meeting of the Society, the announcement of papers for the next Meeting cannot be made in this publication unless the papers are in the hands of the Secretaries by noon on that day.

At the next meeting, on Thursday, January 19th, the following papers will be communicated.

"Researches on moorland waters. I. Acidity." By W. Ackroyd.

"α-Ketotetrahydronaphthalene." By F. Stanley Kipping, D.Sc., F.R.S., and Alfred Hill.

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